PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-156387
(43)Date of publication of application : 17.06.1997

(51)Int.Cl. B60K 17/04
B60L 11/14
H02P 9/04

(21)Application number : 07-344542
(22)Date of filing : 05.12.1995

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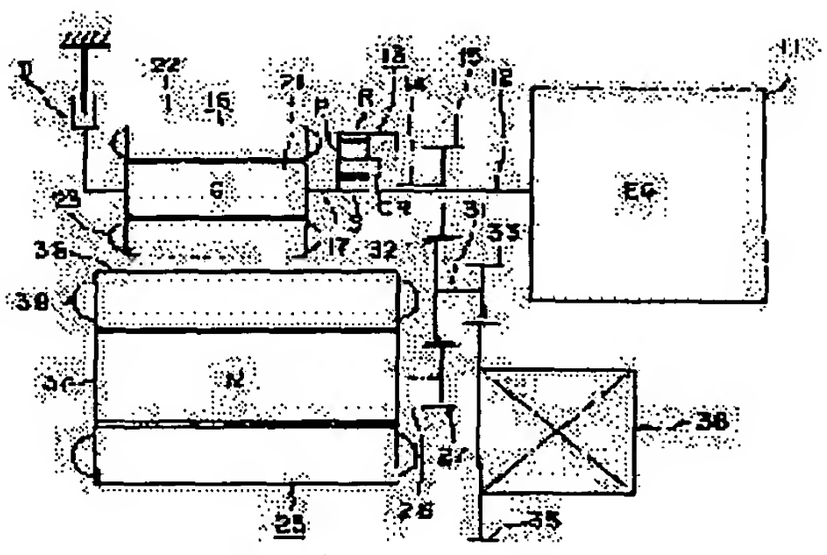
(54) HYBRID VEHICLE

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce the shock of engagement of a brake provided in a generator.
SOLUTION: This hybrid vehicle, in which an engine 11, a generator 16, and a drive output shaft 31 are connected to the gear elements of a planetary gear unit 13 so that it is driven by the output of an electric motor 25 connected to the drive output shaft 31 and by engine output, is designed to be capable of traveling in a non-generating mode in which the generator 16 is stopped by a brake B and in a generating mode in which the brake B is released, and the shock of engagement is reduced by engaging the brake B after bringing the number of revolutions of the generator close to zero. Also, the output torque of the electric motor 25 is adjusted in order to compensate for torque fluctuations during the control of the number of revolutions of the generator, and an upper limit is provided for the rate of change in the number of revolutions of the generator to reduce adverse effects on the engine 11.



LEGAL STATUS

[Date of request for examination]	09.02.1999
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3167607
[Date of registration]	09.03.2001
[Number of appeal against examiner's decision of rejection]	

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The hybrid vehicles characterized by providing the following. Engine. The generator in which revolving speed control is possible. The drive output shaft which outputs the driving force of a driving wheel. The differential gear mechanism with which the 1st gearing element was connected with the output shaft of the aforementioned engine, the 2nd gearing element was connected with Rota of the aforementioned generator, and the 3rd gearing element was connected with the aforementioned drive output shaft, The engagement means arranged between the electric motor connected with the aforementioned drive output shaft, and Rota of the aforementioned generator and a stop member, Engagement control means which make the aforementioned engagement means an engagement state when the relative rotational frequency of the generator control means which control the rotational frequency of the aforementioned generator, and the Rota and the aforementioned stop member which were controlled by the aforementioned generator control means becomes within limits defined beforehand.
[Claim 2] The aforementioned stop members are hybrid vehicles according to claim 1 which are the cases which fix Rota of the aforementioned generator.
[Claim 3] The aforementioned stop members are hybrid vehicles according to claim 1 which are either among the gearing element of the above 1st, and the gearing element of the above 3rd.
[Claim 4] Furthermore, the hybrid vehicles according to claim 1 to 3 which have an amendment torque amendment means for the motor output torque of the aforementioned electric motor according to torque change produced by the revolving speed control by the aforementioned generator control means.
[Claim 5] The aforementioned generator control means are hybrid vehicles according to claim 1 to 4 which control the rate of change of the rotational frequency of the aforementioned generator within limits which were able to be defined beforehand.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the hybrid vehicles which run an engine and a motor as a driving source.
[0002]
[Description of the Prior Art] In order to realize low pollution and low mpg conventionally, the hybrid vehicles which have the driving gear which used the engine and the motor together are proposed, for example, a generator and an engine are connected using a differential gear mechanism, and U.S. Pat. No. 3566717 uses a part of output from an engine for power generation, and outputs the remainder to a direct-drive output shaft. By such hybrid vehicles, by controlling rotation of a generator, run mode can be changed to engine motor drive mode, motor drive mode, etc., and charge to the dc-battery of regeneration power and starting of an engine can be performed further.
[0003]
[Problem(s) to be Solved by the Invention] On the other hand, since the engine, the generator, and the drive motor are connected and each rotational frequency and torque are mutually related through a differential gear mechanism in the above-mentioned hybrid vehicles, the brake prepared in the generator for the purpose of making engine brake effective etc. may be made to act, and rotation of a generator may be fixed.
[0004] Here, if the rotational frequency of a generator is suddenly stopped by the brake, a shock will become large, and there will be a possibility that run feeling may be spoiled, and the friction material of a brake will be remarkably exhausted by generation of heat.
[0005] If a shocking absorber like an accumulator is formed in order to absorb such a shock for example, it is necessary to adjust an orifice, an accumulator spring, etc. for every vehicle, and the problem that manufacture and a maintenance take time and effort will arise. Moreover, it is influenced by aging of coefficient of friction of friction material, operational status, temperature, etc., and the effect which it was difficult to be stabilized and to maintain the shocking absorption effect of an accumulator, and was expected is not acquired in many cases.
[0006] Furthermore, if the above-mentioned shocking absorber is attached, a mechanism will become complicated and will become an electric vehicle with few loading spaces with the composition which is not desirable.
[0007] The purpose of this invention is by controlling a generator rotational frequency beforehand to offer the hybrid vehicles which suppressed the shock at the time of engagement of an engagement means.
[0008]
[Means for Solving the Problem] Such a purpose is attained by the following this inventions.
[0009] (1) An engine, the generator in which revolving speed control is possible, and the drive output shaft which outputs the driving force of a driving wheel, The differential gear mechanism with which the 1st gearing element was connected with the output shaft of the aforementioned engine, the 2nd

gearing element was connected with Rota of the aforementioned generator, and the 3rd gearing element was connected with the aforementioned drive output shaft, The engagement means arranged between the electric motor connected with the aforementioned drive output shaft, and Rota of the aforementioned generator and a stop member, The hybrid vehicles characterized by having the engagement control means which make the aforementioned engagement means an engagement state when the relative rotational frequency of the generator control means which control the rotational frequency of the aforementioned generator, and the Rota and the aforementioned stop member which were controlled by the aforementioned generator control means becomes within limits defined beforehand.
[0010] (2) The aforementioned stop members are hybrid vehicles given in the above (1) which is the case which fixes Rota of the aforementioned generator.
[0011] (3) the aforementioned stop member -- the gearing element of the above 1st, and the gearing element of the above 3rd -- inner -- hybrid vehicles given in the above (1) which is either
[0012] (4) The above (1) which furthermore has an amendment torque amendment means for the motor output torque of the aforementioned electric motor according to torque change produced by the revolving speed control by the aforementioned generator control means, or hybrid vehicles given in either of (3).
[0013] (5) The aforementioned generator control means are hybrid vehicles the above (1) which controls the rate of change of the rotational frequency of the aforementioned generator within limits which were able to be defined beforehand, or given in either of (4).
[0014]
[Function] The rotational frequency of a generator is controlled by generator control means, and after dropping a rotational frequency to the rotational frequency when changing into an engagement state by the engagement means, an engagement means is made into an engagement state by engagement control means. Thereby, in between [before making an engagement means engaged, after making it engaged], since there are few differences of the rotational frequency of a generator, the shock at the time of engagement by the engagement means is suppressed.
[0015] When a stop member is a case, generator control means control the rotational frequency of a generator so that the rotational frequency of a generator serves as zero, and an engagement means is engaged. An engagement means is made engaged, when a stop member is the 1st gearing element or the 3rd gearing element and the rotational frequency of the 2nd gearing element connected to Rota of a generator becomes the same as the rotational frequency of other 1st gearing element or the 3rd gearing element. Thereby, the 1st gearing element, the 2nd gearing element, and the 3rd gearing element rotate as one.
[0016] If the rotational frequency of a generator is controlled by generator control means, the output torque outputted to a drive output shaft from a differential gear mechanism will be changed. the motor output torque of the electric motor connected with the drive output shaft here -- a torque amendment means -- change of an output torque -- responding -- an amendment -- engagement of an engagement means can be performed by things, without spoiling run feeling
[0017] Since an engine may blow the rotational frequency of a generator when making it change to the rotational frequency at the time of engagement of an engagement means and the rate of change of a rotational frequency is too large, and the same shock as a riser and the shock at the time of engagement may arise by generator control means, it is controlled so that the rate of change of a rotational frequency does not exceed within the limits defined beforehand.
[0018]
[Embodiments of the Invention]
The 1st operation gestalt of the hybrid vehicles of this invention is explained in detail based on an accompanying drawing below the <1st operation gestalt>.
[0019] Drawing 1 is the conceptual diagram showing the driving gear of the hybrid vehicles of the 1st operation gestalt of this invention. The engine output shaft 12 which outputs the rotation generated by making an engine 11 and an engine 11 drive on the 1st axis in drawing, The planetary gear unit 13 which is the differential gear mechanism which changes gears to the rotation inputted through this

engine output shaft 12, The unit output shaft 14 to which the rotation after the gear change in this planetary gear unit 13 is outputted, The transfer shaft 17 which connects the 1st counter drive gear 15 fixed to this unit output shaft 14, the generator 16 which acts mainly as generators in a run state, this generator 16, and the planetary gear unit 13 is usually arranged. The unit output shaft 14 has a sleeve configuration, surrounds the engine output shaft 12 and is arranged. Moreover, the 1st counter drive gear 15 is arranged in the engine 11 side from the planetary gear unit 13.

[0020] The planetary gear unit 13 is equipped with the carrier CR which is the 1st gearing element supported free [rotation of the starter ring R and Pinion P which are the 3rd gearing element which gears with the pinion P which gears with the sun gear S which is the 2nd gearing element, and a sun gear S, and this pinion P].

[0021] A sun gear S is connected with a generator 16 through the transfer shaft 17, a starter ring R is connected with the 1st counter drive gear 15 through the unit output shaft 14, and Carrier CR is connected with the engine 11 through the engine output shaft 12.

[0022] Furthermore, it was fixed to the transfer shaft 17 and the generator 16 is equipped with Rota 21 arranged free [rotation], the stator 22 arranged around this Rota 21, and the coil 23 around which this stator 22 was looped. A generator 16 generates power by rotation transmitted through the transfer shaft 17. It connects with the battery which is not illustrated, and the aforementioned coil 23 supplies power to this battery, and charges it.

[0023] The brake B which is an engagement means is connected to the other end side of the transfer shaft 17, by making this brake B into an engagement state, Rota 21 is fixed to a generator 16 and rotation of a generator 16 and rotation of a sun gear S are stopped. On the 2nd axis parallel to the 1st axis, the electric motor 25, the motor output shaft 26 to which rotation of an electric motor 25 is outputted, and the 2nd counter drive gear 27 fixed to the motor output shaft 26 are arranged.

[0024] It was fixed to the motor output shaft 26, and the electric motor 25 is equipped with Rota 37 arranged free [rotation], the stator 38 arranged around this Rota 37, and the coil 39 around which this stator 38 was looped. An electric motor 25 generates torque by the current supplied to a coil 39. Therefore, it connects with the battery which is not illustrated, and the coil 39 is constituted so that current may be supplied from this battery.

[0025] The hybrid vehicles of this invention generate regeneration power in response to rotation in a slowdown state from the driving wheel which an electric motor 25 does not illustrate, and this regeneration power is supplied to a battery and it charges. And in order to rotate the driving wheel which is not illustrated in the same direction as rotation of the aforementioned engine 11, on the 3rd axis parallel to the 1st axis and the 2nd axis, the counter shaft 31 is arranged as a drive output shaft. The counter driven gear 32 is being fixed to this counter shaft 31.

[0026] moreover, this counter driven gear 32, the 1st counter drive gear 15, and the counter driven gear 32 and the 2nd counter drive gear 27 make it gear -- having -- the [of the 1st counter drive gear 15 / rotation and] -- rotation of 2 counter drive gear 27 is reversed, and it is transmitted to the counter driven gear 32

[0027] Furthermore, the differential-gear pinion gear 33 with a number of teeth smaller than the counter driven gear 32 is fixed to the counter shaft 31. And the differential-gear starter ring 35 is arranged on the 4th axis parallel to the 1st axis, the 2nd axis, and the 3rd axis, and this differential-gear starter ring 35 and the aforementioned differential-gear pinion gear 33 are meshed. Moreover, differential equipment 36 is fixed to the aforementioned differential-gear starter ring 35, and by the aforementioned differential equipment 36, the rotation transmitted to the differential-gear starter ring 35 is made to carry out differential, and is transmitted to a driving wheel. The drive output system is constituted by the planetary gear unit 13, a generator 16, the 1st counter drive gear 15, the counter driven gear 32, the 2nd counter drive gear 27, the counter shaft 31, the differential-gear pinion gear 33, the differential-gear starter ring 35, and differential equipment 36 in the above-mentioned composition.

[0028] Thus, since it not only can transmit the rotation generated with the engine 11 to the counter driven gear 32, but the rotation generated by the electric motor 25 can be transmitted to the counter driven gear 32, it can be made to run hybrid vehicles in the engine motor drive mode in which the

engine drive mode in which only an engine 11 is driven, the motor drive mode in which only an electric motor 25 is driven, an engine 11, and an electric motor 25 are driven. Moreover, the rotational frequency of the aforementioned transfer shaft 17 is controllable by controlling the power generated in a generator 16. Moreover, when stopping rotation of a generator, Rota 21 of charge doubling, now a generator 16 can be fixed for Brake B. In this case, by carrying out engagement release of the brake B, it can consider as the mode it runs while generating electricity with a generator 16 in the state of brake release, and can consider as the mode it runs, without generating electricity with a generator 16 in the state of brake engagement.

[0029] Operation of the planetary gear unit 13 of the hybrid vehicles of the above-mentioned composition is explained. The velocity diagram at the time of the usual run of the planetary gear unit [in / the 1st operation form of this invention / drawing 2 (A) and / in drawing 2 (B)] 13 to the conceptual diagram of the planetary gear unit 13 (drawing 1) of the 1st operation form of this invention and drawing 3 are the torque diagrams at the time of a usual run of the planetary gear unit 13 in the 1st operation form of this invention.

[0030] In this operation form, the number of teeth of the starter ring R of the planetary gear unit 13 serves as double precision of the number of teeth of a sun gear S as shown in drawing 2 (A). Therefore, the rotational frequency of the unit output shaft 14 connected to a starter ring R (it is called a "starter-ring rotational frequency" below.) The rotational frequency of the engine output shaft 12 connected to Carrier CR (it is called a "engine speed" below.) The rotational frequency of the transfer shaft 17 which sets to NE and is connected to a sun gear S (it is called a "generator rotational frequency" below.) It is [0031] as the relation of NR, NE, and NG is shown in drawing 2 (B), when referred to as NG. NG=3 and NE-2, NR [0032] It becomes. Moreover, it is [0033] as the relation of TR, TE, and TG is shown in drawing 3 , when torque (henceforth "starter-ring torque") outputted to the unit output shaft 14 from a starter ring R is set to TR, torque (henceforth a "engine torque") of an engine 11 is set to TE and generator torque is set to TG. It is set to TE:TR:TG=3:2:1.

[0034] And each is rotated for a starter ring R, Carrier CR, and a sun gear S by the right direction at the time of a usual run of hybrid vehicles, and as shown in drawing 2 (B), the starter-ring rotational frequency NR (= output rotational frequency NOUT), the rotational frequency NE of an engine, and the generator rotational frequency NG all take a positive value.

[0035] And an engine torque TE is inputted into Carrier CR, and this engine torque TE can receive with the reaction force of the 1st counter drive gear 15 shown in drawing 1 , and a generator 16. Consequently, the starter-ring torque TR is outputted to the unit output shaft 14 from a starter ring R, and the generator torque TG is outputted to the transfer shaft 17 from a sun gear S as shown in drawing 3 .

[0036] The above-mentioned starter-ring torque TR and the generator torque TG are acquired by dividing an engine torque TE proportionally by the torque ratio determined with the number of teeth of the planetary gear unit 13, and what added the starter-ring torque TR and the generator torque TG on the torque diagram serves as an engine torque TE.

[0037] Next, the control system of the hybrid vehicles of this invention is explained in detail based on the block diagram of drawing 4 . The control means which constitute the control system of this operation form have the vehicles control unit 41, an engine control system 42, motor control equipment 43, and arrangement for controlling electric generator 44. The microcomputer equipped with ROM (lead-on memory) in which CPU (central processing unit), and various programs and data were stored, RAM (random access memory) used as a working area can constitute these control units 41, 42, 43, and 44.

[0038] Furthermore, this control system is equipped with the accelerator sensor 45 which detects the accelerator opening alpha which shows the degree of demand to an operator's vehicles driving force, and the vehicle speed sensor 46 which detects the vehicle speed V. The detection value detected by each sensor 45 and 46 is supplied to the vehicles control unit 41.

[0039] The vehicles control unit 41 controls the whole hybrid vehicles, determines torque TM* according to the vehicle speed V from the accelerator opening alpha and the vehicle speed sensor 46

from the accelerator sensor 45, makes this motor torque instruction value TM*, and supplies it to motor control equipment 43. Moreover, amendment torque deltaTM required in order to absorb the torque change by the revolving speed control of a generator 16 by the electric motor 25 is supplied to motor control equipment 43.

[0040] Amendment torque deltaTM is computed as follows. If generator inertia is set to InG and the rotation rate of change (angular acceleration) of a generator 16 is set to betaG, the sun gear torque TS which acts on a sun gear S will be set to TS=TG+InG-beta G. In addition, rotation rate-of-change betaG turns into TS=TG, in being very small. And as mentioned later, when the number of teeth of a starter ring R is the double precision of a sun gear S, the starter-ring torque TR serves as double precision of the generator torque TG, and change torque (amendment torque) deltaTM which should be absorbed by the electric motor 25 will become deltaTM=2, i-TS=2, and i- (TG+InG-betaG), if a counter-gear ratio is set to i.

[0041] Moreover, the vehicles control unit 41 supplies an engine ON/OFF signal to an engine control system 42. Specifically according to ON/OFF of an ignition key, an engine ON/OFF signal is supplied.

[0042] The vehicles control unit 41 supplies control-objectives rotational frequency NG* of a generator 16 to arrangement for controlling electric generator 44. As function NG*=f (alpha) of the accelerator opening alpha supplied from the accelerator sensor 45, target rotational frequency NG* is decided as shown in drawing 5 . That is, in the case of alpha> 20% of accelerator opening, target rotational frequency NG* is greatly decided in proportion to the accelerator opening alpha, and is decided to be alpha<=20% of case by NG*=0.

[0043] Furthermore, the vehicles control unit 41 supplies an ON/OFF signal to the electro-magnetic valve 54 which operates Brake B. The solenoid built in the electro-magnetic valve 54 based on the ON/OFF signal supplied operates, for example, when it is ON signal, a solenoid operates, a bulb is opened wide, the pressure oil from an oil pump is supplied to a brake actuator, Brake B is made into an engagement state, in the case of an OFF signal, a bulb is closed and an electro-magnetic valve 54 cancels engagement of Brake B. Engagement control means consist of a hydraulic circuit equipped with the electro-magnetic valve 54 and the brake actuator, and a vehicles control unit 41.

[0044] The vehicles control unit 41 performs the following operation, in order to suppress the shock by engagement of Brake B. In order to suppress the shock produced by engagement of Brake B, it is necessary to lessen change of the torque by engagement of Brake B, and the change torque of the generator 16 at the time of brake engagement is acquired by delta TG=InG-beta G like previous statement. That is, by lessening betaG for rotation rate of change, the shock by brake engagement can be made small, and consumption of friction material can also be mitigated. The vehicles control unit 41 controls the generator rotational frequency NG to become a rotational frequency at the time of brake B engagement (zero), before supplying ON signal to an electro-magnetic valve 54, and it is engaged in Brake B after that. Consumption of the friction material of Brake B is not enlarged at this time, but Brake B is engaged, when making Brake B engaged is set up as a range as which ****** rotational frequency allowed value deltaNG* was determined beforehand and absolute value |NG| of a real rotational frequency becomes small from rotational frequency allowed value deltaNG* in the range which does not tell an operator a shock. Since rotation rate-of-change betaG when a rotational frequency changes from before brake B engagement to the engagement back becomes small by this, the shock at the time of brake engagement is mitigated.

[0045] An engine control system 42 is switched to the drive state (ON state) which is outputting the engine torque for the engine 11, and the state (OFF state) where the engine torque is not generated and where it does not drive, based on the selection command signal inputted from the vehicles control unit 41. Moreover, the output of an engine 11 is controlled by controlling the throttle opening theta according to the actual engine speed NE inputted from the rotational frequency sensor formed in the engine 11. This engine speed NE and the throttle opening theta are inputted also into the vehicles control unit 41.

[0046] Motor control equipment 43 controls the current (torque) IM of an electric motor 25 to become TM=TM*, when amendment torque deltaTM is not supplied when amendment torque deltaTM is

supplied from the vehicles control unit 41 so that it may be set to TM=TM*-deltaTM and. Always defined torque TM* is maintained by this, without influencing an output torque of the revolving speed control of a generator 16. A torque amendment means is constituted by the vehicles control unit 41 and motor control equipment 43.

[0047] Arrangement for controlling electric generator 44 controls the rotational frequency NG of a generator 16, and controls Current (torque) IG to become control-objectives rotational frequency NG inputted from the vehicles control unit 41, or control-objectives torque TG*. Moreover, arrangement for controlling electric generator 44 acts to the output torque TG of a generator 16 as the monitor of the real rotational frequency NG of a generator 16, and inputs the value into the vehicles control unit 41, respectively. Generator control means are constituted by the vehicles control unit 41 and arrangement for controlling electric generator 44.

[0048] Next, operation of the hybrid vehicles of this operation form constituted as mentioned above is explained. By the hybrid vehicles of this operation form, the accelerator opening alpha fixes rotation of a generator by making Brake B into an engagement state, in being small. By this, it becomes unnecessary to pass current to a generator 16, the power consumption in a generator 16 can be mitigated, and power can be saved.

[0049] Moreover, since the accelerator opening alpha becomes large [the power consumption of an electric motor 25] in being large, in proportion to the accelerator opening alpha, the rotational frequency of a generator 16 is raised by making Brake B into an open state, and the amount of power generation is made to increase. With this operation form, when the accelerator opening alpha is 20% or less, Brake B is made engaged and a generator 16 is fixed, and when it is 20% or more, it generates electricity by opening Brake B wide.

[0050] Hereafter, the control action of hybrid vehicles is explained in detail. Drawing 6 is a flow chart which shows the control action of hybrid vehicles. The accelerator opening alpha is read in the accelerator sensor 45 (Step S11), and the accelerator opening alpha judges whether it is 20% or less (Step S12). When the accelerator opening alpha is 20% or less, as for the vehicles control unit 41, Brake B judges whether it is an engagement state (ON state) (Step S13). In being in an engagement state, it maintains (Step S13:Y) and a state as it is, and a return is carried out to a main routine.

[0051] When it is got blocked and the accelerator opening alpha is 20% or less, when Brake B is in a release state (OFF state), and Brake B is in a release state (Step S13: N), it judges whether rotation of a generator 16 may be fixed. That is, absolute value |NG| of the generator rotational frequency NG judges whether it is below allowed value deltaNG* (Step S14).

[0052] | In being NG|<deltaNG*, (Step S14:Y) and the vehicles control unit 41 supply ON signal to an electro-magnetic valve 54, are engaged (Step S18) and carry out the return of the brake B to a main routine. A generator 16 is fixed by engagement of Brake B and the power loss in a generator 16 is suppressed.

[0053] | In being NG|>=deltaNG*, it is referred to as NG*=0 according to (Step S14:N) and drawing 5 (Step S15), and supply this to arrangement for controlling electric generator 44 (Step S16). Here, the vehicles control unit 41 acts as the monitor of the generator real rotational frequency NG through arrangement for controlling electric generator 44, and it judges whether absolute value |NG| of the generator rotational frequency NG became below allowed value deltaNG* like Step 14 (Step S17). | Repeat Step S17 until it becomes NG|<deltaNG* (Step S17: N), and by control by arrangement for controlling electric generator 44, when it becomes |NG|<deltaNG* (step S17:Y), supply ON signal to an electro-magnetic valve 54, and the vehicles control unit 41 is engaged (Step S18), and carries out the return of the brake B to a main routine.

[0054] Here, in Step S16, after target rotational frequency NG* is supplied, by the control action by which arrangement for controlling electric generator 44 turns the real rotational frequency NG to target rotational frequency NG*, and controls it, the real rotational frequency NG is controlled in the range which does not exceed upper limit rate-of-change deltaNGMAX (rpm/sec) whose rate of change of the real rotational frequency NG is the range defined beforehand. Since the generator 16 and the engine 11 are connected through the planetary gear unit 13, when the rotational frequency NG of a generator 16 is

controlled rapidly, they have an engine 11 or a possibility of having a bad influence on the amount and mpg of exhaust gas, such as blowing up. Then, the above-mentioned upper limit rate-of-change deltaNGMAX is set up as rate of change of the limitation which does not do the above-mentioned bad influence.

[0055] Drawing 7 shows upper limit rate-of-change deltaNGMAX. Upper limit rate-of-change deltaNGMAX is set up so that it may become so large that the value of the accelerator opening alpha is large as illustrated. In addition, this upper limit rate-of-change deltaNGMAX is good also as constant value, without setting up as a function of the accelerator opening alpha.

[0056] In Step S12, in being larger than 20%, Brake B judges [the accelerator opening alpha inputted at Step S11] whether it is an engagement state (ON state) (Step S19). When Brake B is in a release state (OFF state), after (Step S19:N) and the vehicles control unit 41 determine target rotational frequency NG* of a generator 16 from the accelerator opening alpha (Step S20) and supply this to arrangement for controlling electric generator 44 based on drawing 5 (Step S21), the return of them is carried out to a main routine. On the other hand, when Brake B is in an engagement state, (Step S19:Y) and the vehicles control unit 41 hold the torque TG of a generator 16 to set point TG* which becomes settled by the engine torque TE in order to hold the rotational frequency of a generator 16 (Step S22). Then, the vehicles control unit 41 supplies an OFF signal to an electro-magnetic valve 54, opens engagement of Brake B wide, and makes it a release state (OFF state) (Step S23).

[0057] Next, operation of the driving gear of the hybrid vehicles of this invention is explained based on the timing diagram shown in drawing 8 . At time t1, it gets into an accelerator, accelerator opening changes to alpha 2 from alpha 1, and time t2 explains operation when accelerator opening changes from alpha 2 to alpha 1 as shown in drawing 8 . Here, you may be alpha1<20%, alpha 2>20%.

[0058] As for a generator 16, accelerator opening is fixed by engaging Brake B in the state of alpha 1 (ON state), the rotational frequency has become a zero state, and the generator torque TG also serves as zero. Moreover, it is the motor [torque / motor / TM] torque TM 1 according to the accelerator opening alpha 1. It has become.

[0059] time t1 the output torque corresponding to the accelerator opening alpha 2 when it set and accelerator opening changed from alpha 1 to alpha 2 -- it should output -- the motor torque TM -- TM1 from -- TM2 It goes up. Brake B is in ON state at this time (a dotted line A shows drawing 8 .). It is below the same.

[0060] In order for the engine 11 by release of Brake B to blow and to prevent a riser, generator torque is beforehand raised to generator torque TG* which becomes settled by the engine torque TE at that time. After becoming TG=TG*, in time t12, Brake B is taken off (OFF) and a generator raises the generator rotational frequency NG below by the rotational frequency rate of change defined beforehand simultaneously (dotted line B). In this operation gestalt, while ordering it target rotational frequency NG* of a generator 16, the generator torque TG is always computed and amendment torque deltaTM is added (dotted line C). For this reason, amendment torque deltaTM according to change of the generator torque TG is added to the motor torque TM as shown in drawing 8 (dotted line D).

[0061] The generator rotational frequency NG reaches target rotational frequency NG*, without going up rapidly (dotted line E). since there is no upheaval of the generator rotational frequency NG in the meantime -- an engine 11 -- blowing up -- etc. -- a bad influence called the aggravation of mpg and the increase in an exhaust gas to depend is not produced

[0062] the attainment, simultaneously the generator 16 to target rotational frequency NG* are controlled to hold target rotational frequency NG* Since elevation of the generator rotational frequency NG stops, the absolute value of the generator torque TG becomes larger than the time of the rotational frequency rising (dotted line F). If amendment torque deltaTM is added to the motor torque TM (dotted line G) and the generator rotational frequency NG also reaches target rotational frequency NG* in the meantime, since the absolute value of the generator torque TG will become large, the motor torque TM becomes small about it at an amendment sake (dotted line H).

[0063] When accelerator opening changes to alpha 1 from alpha 2, the motor torque TM is TM2 that the output torque according to the accelerator opening alpha 1 should be outputted. Shell TM 1 It descends.

Brake B is in the OFF state at this time (dotted line I). Next, the generator torque TG is made to increase and amendment torque deltaTM according to change of the generator torque TG is simultaneously amended to the motor torque TM to make the generator rotational frequency NG into the zero which are a rotational frequency in a brake engagement state (ON) (dotted line J). When the generator rotational frequency NG descends, without changing rapidly (dotted line K) and it becomes small rather than deltaNG*, it is time t22 and Brake B is engaged (dotted line L). (ON) since there is no upheaval of the generator rotational frequency NG in the meantime -- an engine 11 -- blowing up -- etc. -- a bad influence called the aggravation of mpg and the increase in an exhaust gas to depend is not produced [0064] since, as for the motor torque TM, torque amendment is performed (dotted line M), maintenance of run feeling is achieved and the generator torque TG becomes small with engagement of Brake B, while the generator rotational frequency NG is descending -- the motor torque TM -- the part -- it becomes large -- it becomes (dotted line N) And when a generator 16 is completely fixed by Brake B, the generator torque TG serves as zero (dotted line O).

[0065] Although the above explanation explained the control action to which the accelerator opening alpha carries out engagement release of the brake B bordering on the state of being 20% In this invention, it is not what is limited to the above-mentioned operation. by manual operation It can apply, when switching to the mode it runs while generating run mode with a generator 16, and the mode it runs, without generating electricity with a generator 16. In addition, in order to make engine brake act, when it fixes Rota 21 of a generator 16 and fixes Rota 21 of a generator 16 during a run, it can use.

[0066] In addition, what kind of brake is sufficient as the brake B used in the operation gestalt which gave [above-mentioned] explanation. In this case, although any of a wet brake and a dry type brake are sufficient, it is desirable to use a wet brake at the point which is easy to control a rotational frequency.

[0067] The <2nd operation gestalt>, next the 2nd operation gestalt of this invention are explained. Drawing 9 is the conceptual diagram showing the composition of the driving gear of the 2nd operation gestalt. By the hybrid vehicles of this operation gestalt, in the planetary gear unit 13, the clutch C which is an engagement means is formed between Carrier CR and the sun gear S, and the brake B currently arranged by the generator 16 in the 1st operation gestalt is not formed. Moreover, as for Clutch C, engagement and release are controlled by the actuator by which an ON/OFF signal is supplied from the vehicles control unit 41. About other structures, since it is the same as that of the 1st operation gestalt, the same sign is given to the same composition as drawing 1 , and explanation is omitted.

[0068] Operation of the driving gear of the 2nd operation gestalt is explained. Clutch C is usually in the release state (OFF state) at the time of a run, and is made into an engagement state (ON state) at the time of acceleration.

[0069] Usually, by the time of a run, the planetary gear unit 13 has become open, and it is rotating at the rotational frequency of which Clutch C is canceled and from which a sun gear S, Carrier CR, and a starter ring R differ independently, respectively as shown in drawing 2 (B). With the **** 2 operation gestalt, since the number of teeth of a starter ring R serves as double precision of a sun gear S, the gear ratio of an engine 11 to the unit output shaft 14 is two thirds.

[0070] And in the time of the acceleration run with which Clutch C is engaging, each gearing element of the planetary gear unit 13 is really rotated, and becomes the same [the rotational frequency of each gearing element]. The gear ratio of an engine 11 to the unit output shaft 14 at this time is set to 1, and the output transmitted to the unit output shaft 14 from an engine 11 increases by 1.5 times as compared with the time of Clutch C being in a release state. The output transmitted to the counter shaft 31 which is a drive output shaft by this increases, and acceleration is performed.

[0071] Next, the control action of the 2nd operation gestalt is explained. Drawing 10 is a timing diagram which shows control action. Hereafter, from the state of alpha 1, it is made to increase to alpha 2 and accelerator opening is accelerated, and control action at the time of changing the accelerator opening after an acceleration end to alpha 3 is made into an example, and it explains.

[0072] Usually, in the run state, Clutch C is in the release state (OFF state) by alpha 1, and accelerator opening is set as the value [torque / motor / TM / the rotational frequency NG of a generator 16, Torque TG, and] corresponding to the accelerator opening alpha 1 and the vehicle speed V respectively.

[0073] time t1 the output torque corresponding to the accelerator opening alpha 2 in order to set and accelerate, when accelerator opening was made to increase to alpha 2 from alpha 1 -- it should output -- the motor torque TM -- TM1 from -- TM2 It goes up. Clutch C is in the OFF state at this time (a dotted line a shows drawing 8 .). It is below the same.
[0074] In order to consider as the output rotational frequency NOUT into which the generator rotational frequency NG is inputted by the generator 16 at the starter ring R, it is target rotational frequency NG*2. It is set as NOUT and the generator torque TG is decreased. Thereby, the generator rotational frequency NG is target rotational frequency NG*2. It turns and begins (dotted line b) to increase. To the motor torque TM, amendment torque deltaTM according to change of the generator torque TG is amended simultaneously (dotted line c). The generator rotational frequency NG rises, without changing rapidly (dotted line d), and is the real rotational frequency NG and target rotational frequency NG*2. When a difference becomes smaller than deltaNG*, it is time t12 and Clutch C is engaged (dotted line g). (ON) Here, deltaNG* is the real rotational frequency NG at the time of being the value set up in the range which does not enlarge exhaustion of the friction material of Clutch C and does not tell an operator a shock, and making Clutch C engaged, and target rotational frequency NG*2. It is the allowed value of a difference.
[0075] Time t2 If it sets, and an acceleration run is completed, accelerator opening is decreased from alpha 2 to alpha 3 and it is usually a run, the motor torque TM will be decreased according to the accelerator opening alpha (dotted line j). Moreover, in order for the engine 11 by canceling Clutch C in the state where torque is not added to a generator 16 to blow and to suppress a riser, it asks for generator torque TG* which becomes settled by the engine torque TE at that time, and generator torque is beforehand raised to TG* (dotted line i).
[0076] It is target rotational frequency NG*3 so that Clutch C may be canceled in time t22 after becoming TG=TG* (OFF), and the generator rotational frequency NG may not exceed the upper limit of rotational frequency rate of change simultaneously. It turns and begins (dotted line k) to descend. Moreover, amendment torque deltaTM according to change of the generator torque TG is added to the motor torque TM (dotted line m). The generator rotational frequency NG is target rotational frequency NG*3, without descending rapidly (dotted line n). It reaches.
[0077] In addition, although any of a wet clutch and a dry clutch are sufficient as the clutch C used in the operation gestalt which gave [above-mentioned] explanation, it is desirable to use a wet clutch at the point which can mitigate the shock at the time of engagement. By using a wet clutch, the shock at the time of clutch C engagement can be suppressed further.
[0078] Moreover, the clutch C which is the above-mentioned engagement means may be formed between the sun gear S which is the 2nd gearing element, and the starter ring R which is the 3rd gearing element, and may be prepared between Carrier CR and the starter ring R. The control method of the generator rotational frequency NG in this case is the same as that of the case of the above-mentioned 2nd operation gestalt.
[0079]
[Effect of the Invention] The shock at the time of engagement by **** and the engagement means whose difference of the rotational frequency of a generator decreases is suppressed in between [after invention according to claim 1 explained above made it engaged before making an engagement means engaged]. Thereby, the endurance of an engagement means improves, and since the thermal load which friction material receives especially is mitigated, the endurance of friction material improves remarkably. Moreover, tuning of a buffer etc. becomes unnecessary, while simplification and lightweight-izing of a drive are realizable, since equipments, such as an accumulator which buffers the shock at the time of engagement, become unnecessary. Furthermore, since it is rare to receive a bad influence from aging of friction material, change of operational status and temperature, etc., the stable shock depressor effect continues and is obtained.
[0080] Invention according to claim 2 can suppress the shock by the magneto-rotor fixation at the time of switching to a non-generating electricity run from a power generation run.
[0081] Invention according to claim 3 can suppress the shock by the clutch engagement when usually

moving from a run to an acceleration run, for example.
[0082] Since invention according to claim 4 amends motor torque and absorbs torque change produced at the time of generator revolving speed control, it can maintain run feeling in the good state.
[0083] By controlling the rate of change of a generator rotational frequency within limits which were able to be defined beforehand, the abrupt change of a generator rotational frequency is suppressed and invention according to claim 5 can lessen the bad influence to mpg, the amount of exhaust gas, etc. of an engine.

[Translation done.]

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the hybrid vehicles which run an engine and a motor as a driving source.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] In order to realize low pollution and low mpg conventionally, the hybrid vehicles which have the driving gear which used the engine and the motor together are proposed, for example, a generator and an engine are connected using a differential gear mechanism, and U.S. Pat. No. 3566717 uses a part of output from an engine for power generation, and outputs the remainder to a direct-drive output shaft. By such hybrid vehicles, by controlling rotation of a generator, run mode can be changed to engine motor drive mode, motor drive mode, etc., and charge to the dc-battery of regeneration power and starting of an engine can be performed further.

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EFFECT OF THE INVENTION

[Effect of the Invention] The shock at the time of engagement by **** and the engagement means whose difference of the rotational frequency of a generator decreases is suppressed in between [after invention according to claim 1 explained above made it engaged before making an engagement means engaged]. Thereby, the endurance of an engagement means improves, and since the thermal load which friction material receives especially is mitigated, the endurance of friction material improves remarkably. Moreover, tuning of a buffer etc. becomes unnecessary, while simplification and lightweight-izing of a drive are realizable, since equipments, such as an accumulator which buffers the shock at the time of engagement, become unnecessary. Furthermore, since it is rare to receive a bad influence from aging of friction material, change of operational status and temperature, etc., the stable shock depressor effect continues and is obtained.
[0080] Invention according to claim 2 can suppress the shock by the magneto-rotor fixation at the time of switching to a non-generating electricity run from a power generation run.
[0081] Invention according to claim 3 can suppress the shock by the clutch engagement when usually moving from a run to an acceleration run, for example.
[0082] Since invention according to claim 4 amends motor torque and absorbs torque change produced at the time of generator revolving speed control, it can maintain run feeling in the good state.
[0083] By controlling the rate of change of a generator rotational frequency within limits which were able to be defined beforehand, the abrupt change of a generator rotational frequency is suppressed and invention according to claim 5 can lessen the bad influence to mpg, the amount of exhaust gas, etc. of an engine.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] On the other hand, since the engine, the generator, and the drive motor are connected and each rotational frequency and torque are mutually related through a differential gear mechanism in the above-mentioned hybrid vehicles, the brake prepared in the generator for the purpose of making engine brake effective etc. may be made to act, and rotation of a generator may be fixed.

[0004] Here, if the rotational frequency of a generator is suddenly stopped by the brake, a shock will become large, and there will be a possibility that run feeling may be spoiled, and the friction material of a brake will be remarkably exhausted by generation of heat.

[0005] If a shocking absorber like an accumulator is formed in order to absorb such a shock for example, it is necessary to adjust an orifice, an accumulator spring, etc. for every vehicle, and the problem that manufacture and a maintenance take time and effort will arise. Moreover, it is influenced by aging of coefficient of friction of friction material, operational status, temperature, etc., and the effect which it was difficult to be stabilized and to maintain the shocking absorption effect of an accumulator, and was expected is not acquired in many cases.

[0006] Furthermore, if the above-mentioned shocking absorber is attached, a mechanism will become complicated and will become an electric vehicle with few loading spaces with the composition which is not desirable.

[0007] The purpose of this invention is by controlling a generator rotational frequency beforehand to offer the hybrid vehicles which suppressed the shock at the time of engagement of an engagement means.

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MEANS

[Means for Solving the Problem] Such a purpose is attained by the following this inventions.
[0009] (1) An engine, the generator in which revolving speed control is possible, and the drive output shaft which outputs the driving force of a driving wheel, The differential gear mechanism with which the 1st gearing element was connected with the output shaft of the aforementioned engine, the 2nd gearing element was connected with Rota of the aforementioned generator, and the 3rd gearing element was connected with the aforementioned drive output shaft, The engagement means arranged between the electric motor connected with the aforementioned drive output shaft, and Rota of the aforementioned generator and a stop member, The hybrid vehicles characterized by having the engagement control means which make the aforementioned engagement means an engagement state when the relative rotational frequency of the generator control means which control the rotational frequency of the aforementioned generator, and the Rota and the aforementioned stop member which were controlled by the aforementioned generator control means becomes within limits defined beforehand.
[0010] (2) The aforementioned stop members are hybrid vehicles given in the above (1) which is the case which fixes Rota of the aforementioned generator.
[0011] (3) the aforementioned stop member -- the gearing element of the above 1st, and the gearing element of the above 3rd -- inner -- hybrid vehicles given in the above (1) which is either
[0012] (4) The above (1) which furthermore has an amendment torque amendment means for the motor output torque of the aforementioned electric motor according to torque change produced by the revolving speed control by the aforementioned generator control means, or hybrid vehicles given in either of (3).
[0013] (5) The aforementioned generator control means are hybrid vehicles the above (1) which controls the rate of change of the rotational frequency of the aforementioned generator within limits which were able to be defined beforehand, or given in either of (4).

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OPERATION

[Function] The rotational frequency of a generator is controlled by generator control means, and after dropping a rotational frequency to the rotational frequency when changing into an engagement state by the engagement means, an engagement means is made into an engagement state by engagement control means. Thereby, in between [before making an engagement means engaged, after making it engaged], since there are few differences of the rotational frequency of a generator, the shock at the time of engagement by the engagement means is suppressed.
[0015] When a stop member is a case, generator control means control the rotational frequency of a generator so that the rotational frequency of a generator serves as zero, and an engagement means is engaged. An engagement means is made engaged, when a stop member is the 1st gearing element or the 3rd gearing element and the rotational frequency of the 2nd gearing element connected to Rota of a generator becomes the same as the rotational frequency of other 1st gearing element or the 3rd gearing element. Thereby, the 1st gearing element, the 2nd gearing element, and the 3rd gearing element rotate as one.
[0016] If the rotational frequency of a generator is controlled by generator control means, the output torque outputted to a drive output shaft from a differential gear mechanism will be changed. the motor output torque of the electric motor connected with the drive output shaft here -- a torque amendment means -- change of an output torque -- responding -- an amendment -- engagement of an engagement means can be performed by things, without spoiling run feeling
[0017] Since an engine may blow the rotational frequency of a generator when making it change to the rotational frequency at the time of engagement of an engagement means and the rate of change of a rotational frequency is too large, and the same shock as a riser and the shock at the time of engagement may arise by generator control means, it is controlled so that the rate of change of a rotational frequency does not exceed within the limits defined beforehand.
[0018]
[Embodiments of the Invention]
The 1st operation gestalt of the hybrid vehicles of this invention is explained in detail based on an accompanying drawing below the <1st operation gestalt>.
[0019] Drawing 1 is the conceptual diagram showing the driving gear of the hybrid vehicles of the 1st operation gestalt of this invention. The engine output shaft 12 which outputs the rotation generated by making an engine 11 and an engine 11 drive on the 1st axis in drawing, The planetary gear unit 13 which is the differential gear mechanism which changes gears to the rotation inputted through this engine output shaft 12, The unit output shaft 14 to which the rotation after the gear change in this planetary gear unit 13 is outputted, The transfer shaft 17 which connects the 1st counter drive gear 15 fixed to this unit output shaft 14, the generator 16 which acts mainly as generators in a run state, this generator 16, and the planetary gear unit 13 is usually arranged. The unit output shaft 14 has a sleeve configuration, surrounds the engine output shaft 12 and is arranged. Moreover, the 1st counter drive gear 15 is arranged in the engine 11 side from the planetary gear unit 13.
[0020] The planetary gear unit 13 is equipped with the carrier CR which is the 1st gearing element

supported free [rotation of the starter ring R and Pinion P which are the 3rd gearing element which gears with the pinion P which gears with the sun gear S which is the 2nd gearing element, and a sun gear S, and this pinion P].
[0021] A sun gear S is connected with a generator 16 through the transfer shaft 17, a starter ring R is connected with the 1st counter drive gear 15 through the unit output shaft 14, and Carrier CR is connected with the engine 11 through the engine output shaft 12.
[0022] Furthermore, it was fixed to the transfer shaft 17 and the generator 16 is equipped with Rota 21 arranged free [rotation], the stator 22 arranged around this Rota 21, and the coil 23 around which this stator 22 was looped. A generator 16 generates power by rotation transmitted through the transfer shaft 17. It connects with the battery which is not illustrated, and the aforementioned coil 23 supplies power to this battery, and charges it.
[0023] The brake B which is an engagement means is connected to the other end side of the transfer shaft 17, by making this brake B into an engagement state, Rota 21 is fixed to a generator 16 and rotation of a generator 16 and rotation of a sun gear S are stopped. On the 2nd axis parallel to the 1st axis, the electric motor 25, the motor output shaft 26 to which rotation of an electric motor 25 is outputted, and the 2nd counter drive gear 27 fixed to the motor output shaft 26 are arranged.
[0024] It was fixed to the motor output shaft 26, and the electric motor 25 is equipped with Rota 37 arranged free [rotation], the stator 38 arranged around this Rota 37, and the coil 39 around which this stator 38 was looped. An electric motor 25 generates torque by the current supplied to a coil 39. Therefore, it connects with the battery which is not illustrated, and the coil 39 is constituted so that current may be supplied from this battery.
[0025] The hybrid vehicles of this invention generate regeneration power in response to rotation in a slowdown state from the driving wheel which an electric motor 25 does not illustrate, and this regeneration power is supplied to a battery and it charges. And in order to rotate the driving wheel which is not illustrated in the same direction as rotation of the aforementioned engine 11, on the 3rd axis parallel to the 1st axis and the 2nd axis, the counter shaft 31 is arranged as a drive output shaft. The counter driven gear 32 is being fixed to this counter shaft 31.
[0026] moreover, this counter driven gear 32, the 1st counter drive gear 15, and the counter driven gear 32 and the 2nd counter drive gear 27 make it gear -- having -- the [of the 1st counter drive gear 15 / rotation and] -- rotation of 2 counter drive gear 27 is reversed, and it is transmitted to the counter driven gear 32
[0027] Furthermore, the differential-gear pinion gear 33 with a number of teeth smaller than the counter driven gear 32 is fixed to the counter shaft 31. And the differential-gear starter ring 35 is arranged on the 4th axis parallel to the 1st axis, the 2nd axis, and the 3rd axis, and this differential-gear starter ring 35 and the aforementioned differential-gear pinion gear 33 are meshed. Moreover, differential equipment 36 is fixed to the aforementioned differential-gear starter ring 35, and by the aforementioned differential equipment 36, the rotation transmitted to the differential-gear starter ring 35 is made to carry out differential, and is transmitted to a driving wheel. The drive output system is constituted by the planetary gear unit 13, a generator 16, the 1st counter drive gear 15, the counter driven gear 32, the 2nd counter drive gear 27, the counter shaft 31, the differential-gear pinion gear 33, the differential-gear starter ring 35, and differential equipment 36 in the above-mentioned composition.
[0028] Thus, since it not only can transmit the rotation generated with the engine 11 to the counter driven gear 32, but the rotation generated by the electric motor 25 can be transmitted to the counter driven gear 32, it can be made to run hybrid vehicles in the engine motor drive mode in which the engine drive mode in which only an engine 11 is driven, the motor drive mode in which only an electric motor 25 is driven, an engine 11, and an electric motor 25 are driven. Moreover, the rotational frequency of the aforementioned transfer shaft 17 is controllable by controlling the power generated in a generator 16. Moreover, when stopping rotation of a generator, Rota 21 of charge doubling, now a generator 16 can be fixed for Brake B. In this case, by carrying out engagement release of the brake B, it can consider as the mode it runs while generating electricity with a generator 16 in the state of brake release, and can consider as the mode it runs, without generating electricity with a generator 16 in the state of brake

engagement.
[0029] Operation of the planetary gear unit 13 of the hybrid vehicles of the above-mentioned composition is explained. The velocity diagram at the time of the usual run of the planetary gear unit [in / the 1st operation gestalt of this invention / drawing 2 (A) and / in drawing 2 (B)] 13 to the conceptual diagram of the planetary gear unit 13 (drawing 1) of the 1st operation gestalt of this invention and drawing 3 are the torque diagrams at the time of a usual run of the planetary gear unit 13 in the 1st operation gestalt of this invention.
[0030] In this operation gestalt, the number of teeth of the starter ring R of the planetary gear unit 13 serves as double precision of the number of teeth of a sun gear S as shown in drawing 2 (A). Therefore, the rotational frequency of the unit output shaft 14 connected to a starter ring R (it is called a "starter-ring rotational frequency" below.) The rotational frequency of the engine output shaft 12 connected to Carrier CR (it is called a "engine speed" below.) The rotational frequency of the transfer shaft 17 which sets to NE and is connected to a sun gear S (it is called a "generator rotational frequency" below.) It is [0031] as the relation of NR, NE, and NG is shown in drawing 2 (B), when referred to as NG. NG=3 and NE-2, NR [0032] It becomes. Moreover, it is [0033] as the relation of TR, TE, and TG is shown in drawing 3 , when torque (henceforth "starter-ring torque") outputted to the unit output shaft 14 from a starter ring R is set to TR, torque (henceforth a "engine torque") of an engine 11 is set to TE and generator torque is set to TG. It is set to TE:TR:TG=3:2:1.
[0034] And each is rotated for a starter ring R, Carrier CR, and a sun gear S by the right direction at the time of a usual run of hybrid vehicles, and as shown in drawing 2 (B), the starter-ring rotational frequency NR (= output rotational frequency NOUT), the rotational frequency NE of an engine, and the generator rotational frequency NG all take a positive value.
[0035] And an engine torque TE is inputted into Carrier CR, and this engine torque TE can receive with the reaction force of the 1st counter drive gear 15 shown in drawing 1 , and a generator 16. Consequently, the starter-ring torque TR is outputted to the unit output shaft 14 from a starter ring R, and the generator torque TG is outputted to the transfer shaft 17 from a sun gear S as shown in drawing 3 .
[0036] The above-mentioned starter-ring torque TR and the generator torque TG are acquired by dividing an engine torque TE proportionally by the torque ratio determined with the number of teeth of the planetary gear unit 13, and what added the starter-ring torque TR and the generator torque TG on the torque diagram serves as an engine torque TE.
[0037] Next, the control system of the hybrid vehicles of this invention is explained in detail based on the block diagram of drawing 4 . The control means which constitute the control system of this operation form have the vehicles control unit 41, an engine control system 42, motor control equipment 43, and arrangement for controlling electric generator 44. The microcomputer equipped with ROM (lead-on memory) in which CPU (central processing unit), and various programs and data were stored, RAM (random access memory) used as a working area can constitute these control units 41, 42, 43, and 44.
[0038] Furthermore, this control system is equipped with the accelerator sensor 45 which detects the accelerator opening alpha which shows the degree of demand to an operator's vehicles driving force, and the vehicle speed sensor 46 which detects the vehicle speed V. The detection value detected by each sensor 45 and 46 is supplied to the vehicles control unit 41.
[0039] The vehicles control unit 41 controls the whole hybrid vehicles, determines torque TM* according to the vehicle speed V from the accelerator opening alpha and the vehicle speed sensor 46 from the accelerator sensor 45, makes this motor torque instruction value TM*, and supplies it to motor control equipment 43. Moreover, amendment torque deltaTM required in order to absorb the torque change by the revolving speed control of a generator 16 by the electric motor 25 is supplied to motor control equipment 43.
[0040] Amendment torque deltaTM is computed as follows. If generator inertia is set to InG and the rotation rate of change (angular acceleration) of a generator 16 is set to betaG, the sun gear torque TS which acts on a sun gear S will be set to TS=TG+InG-beta G. In addition, rotation rate-of-change betaG

turns into TS=TG, in being very small. And as mentioned later, when the number of teeth of a starter ring R is the double precision of a sun gear S, the starter-ring torque TR serves as double precision of the generator torque TG, and change torque (amendment torque) deltaTM which should be absorbed by the electric motor 25 will become deltaTM=2, i-TS=2, and i- (TG+InG-betaG), if a counter-gear ratio is set to i.

[0041] Moreover, the vehicles control unit 41 supplies an engine ON/OFF signal to an engine control system 42. Specifically according to ON/OFF of an ignition key, an engine ON/OFF signal is supplied.

[0042] The vehicles control unit 41 supplies control-objectives rotational frequency NG* of a generator 16 to arrangement for controlling electric generator 44. As function NG*=f (alpha) of the accelerator opening alpha supplied from the accelerator sensor 45, target rotational frequency NG* is decided as shown in drawing 5 . That is, in the case of alpha> 20% of accelerator opening, target rotational frequency NG* is greatly decided in proportion to the accelerator opening alpha, and is decided to be alpha<=20% of case by NG*=0.

[0043] Furthermore, the vehicles control unit 41 supplies an ON/OFF signal to the electro-magnetic valve 54 which operates Brake B. The solenoid built in the electro-magnetic valve 54 based on the ON/OFF signal supplied operates, for example, when it is ON signal, a solenoid operates, a bulb is opened wide, the pressure oil from an oil pump is supplied to a brake actuator, Brake B is made into an engagement state, in the case of an OFF signal, a bulb is closed and an electro-magnetic valve 54 cancels engagement of Brake B. Engagement control means consist of a hydraulic circuit equipped with the electro-magnetic valve 54 and the brake actuator, and a vehicles control unit 41.

[0044] The vehicles control unit 41 performs the following operation, in order to suppress the shock by engagement of Brake B. In order to suppress the shock produced by engagement of Brake B, it is necessary to lessen change of the torque by engagement of Brake B, and the change torque of the generator 16 at the time of brake engagement is acquired by delta TG=InG-beta G like previous statement. That is, by lessening betaG for rotation rate of change, the shock by brake engagement can be made small, and consumption of friction material can also be mitigated. The vehicles control unit 41 controls the generator rotational frequency NG to become a rotational frequency at the time of brake B engagement (zero), before supplying ON signal to an electro-magnetic valve 54, and it is engaged in Brake B after that. Consumption of the friction material of Brake B is not enlarged at this time, but Brake B is engaged, when making Brake B engaged is set up as a range as which ****** rotational frequency allowed value deltaNG* was determined beforehand and absolute value |NG| of a real rotational frequency becomes small from rotational frequency allowed value deltaNG* in the range which does not tell an operator a shock. Since rotation rate-of-change betaG when a rotational frequency changes from before brake B engagement to the engagement back becomes small by this, the shock at the time of brake engagement is mitigated.

[0045] An engine control system 42 is switched to the drive state (ON state) which is outputting the engine torque for the engine 11, and the state (OFF state) where the engine torque is not generated and where it does not drive, based on the selection command signal inputted from the vehicles control unit 41. Moreover, the output of an engine 11 is controlled by controlling the throttle opening theta according to the actual engine speed NE inputted from the rotational frequency sensor formed in the engine 11. This engine speed NE and the throttle opening theta are inputted also into the vehicles control unit 41.

[0046] Motor control equipment 43 controls the current (torque) IM of an electric motor 25 to become TM=TM*, when amendment torque deltaTM is not supplied when amendment torque deltaTM is supplied from the vehicles control unit 41 so that it may be set to TM=TM*-deltaTM and. Always defined torque TM* is maintained by this, without influencing an output torque of the revolving speed control of a generator 16. A torque amendment means is constituted by the vehicles control unit 41 and motor control equipment 43.

[0047] Arrangement for controlling electric generator 44 controls the rotational frequency NG of a generator 16, and controls Current (torque) IG to become control-objectives rotational frequency NG* inputted from the vehicles control unit 41, or control-objectives torque TG*. Moreover, arrangement for

controlling electric generator 44 acts to the output torque TG of a generator 16 as the monitor of the real rotational frequency NG of a generator 16, and inputs the value into the vehicles control unit 41, respectively. Generator control means are constituted by the vehicles control unit 41 and arrangement for controlling electric generator 44.

[0048] Next, operation of the hybrid vehicles of this operation form constituted as mentioned above is explained. By the hybrid vehicles of this operation form, the accelerator opening alpha fixes rotation of a generator by making Brake B into an engagement state, in being small. By this, it becomes unnecessary to pass current to a generator 16, the power consumption in a generator 16 can be mitigated, and power can be saved.

[0049] Moreover, since the accelerator opening alpha becomes large [the power consumption of an electric motor 25] in being large, in proportion to the accelerator opening alpha, the rotational frequency of a generator 16 is raised by making Brake B into an open state, and the amount of power generation is made to increase. With this operation gestalt, when the accelerator opening alpha is 20% or less, Brake B is made engaged and a generator 16 is fixed, and when it is 20% or more, it generates electricity by opening Brake B wide.

[0050] Hereafter, the control action of hybrid vehicles is explained in detail. Drawing 6 is a flow chart which shows the control action of hybrid vehicles. The accelerator opening alpha is read in the accelerator sensor 45 (Step S11), and the accelerator opening alpha judges whether it is 20% or less (Step S12). When the accelerator opening alpha is 20% or less, as for the vehicles control unit 41, Brake B judges whether it is an engagement state (ON state) (Step S13). In being in an engagement state, it maintains (Step S13:Y) and a state as it is, and a return is carried out to a main routine.

[0051] When it is got blocked and the accelerator opening alpha is 20% or less, when Brake B is in a release state (OFF state), and Brake B is in a release state (Step S13: N), it judges whether rotation of a generator 16 may be fixed. That is, absolute value |NG| of the generator rotational frequency NG judges whether it is below allowed value deltaNG* (Step S14).

[0052] | In being NG|<deltaNG*, (Step S14:Y) and the vehicles control unit 41 supply ON signal to an electro-magnetic valve 54, are engaged (Step S18) and carry out the return of the brake B to a main routine. A generator 16 is fixed by engagement of Brake B and the power loss in a generator 16 is suppressed.

[0053] | In being NG|>=deltaNG*, it is referred to as NG*=0 according to (Step S14:N) and drawing 5 (Step S15), and supply this to arrangement for controlling electric generator 44 (Step S16). Here, the vehicles control unit 41 acts as the monitor of the generator real rotational frequency NG through arrangement for controlling electric generator 44, and it judges whether absolute value |NG| of the generator rotational frequency NG became below allowed value deltaNG* like Step 14 (Step S17). | Repeat Step S17 until it becomes NG|<deltaNG* (Step S17: N), and by control by arrangement for controlling electric generator 44, when it becomes |NG|<deltaNG* (step S17:Y), supply ON signal to an electro-magnetic valve 54, and the vehicles control unit 41 is engaged (Step S18), and carries out the return of the brake B to a main routine.

[0054] Here, in Step S16, after target rotational frequency NG* is supplied, by the control action by which arrangement for controlling electric generator 44 turns the real rotational frequency NG to target rotational frequency NG*, and controls it, the real rotational frequency NG is controlled in the range which does not exceed upper limit rate-of-change deltaNGMAX (rpm/sec) whose rate of change of the real rotational frequency NG is the range defined beforehand. Since the generator 16 and the engine 11 are connected through the planetary gear unit 13, when the rotational frequency NG of a generator 16 is controlled rapidly, they have an engine 11 or a possibility of having a bad influence on the amount and mpg of exhaust gas, such as blowing up. Then, the above-mentioned upper limit rate-of-change deltaNGMAX is set up as rate of change of the limitation which does not do the above-mentioned bad influence.

[0055] Drawing 7 shows upper limit rate-of-change deltaNGMAX. Upper limit rate-of-change deltaNGMAX is set up so that it may become so large that the value of the accelerator opening alpha is large as illustrated. In addition, this upper limit rate-of-change deltaNGMAX is good also as constant

value, without setting up as a function of the accelerator opening alpha.
[0056] In Step S12, in being larger than 20%, Brake B judges [the accelerator opening alpha inputted at Step S11] whether it is an engagement state (ON state) (Step S19). When Brake B is in a release state (OFF state), after (Step S19:N) and the vehicles control unit 41 determine target rotational frequency NG* of a generator 16 from the accelerator opening alpha (Step S20) and supply this to arrangement for controlling electric generator 44 based on drawing 5 (Step S21), the return of them is carried out to a main routine. On the other hand, when Brake B is in an engagement state, (Step S19:Y) and the vehicles control unit 41 hold the torque TG of a generator 16 to set point TG* which becomes settled by the engine torque TE in order to hold the rotational frequency of a generator 16 (Step S22). Then, the vehicles control unit 41 supplies an OFF signal to an electro-magnetic valve 54, opens engagement of Brake B wide, and makes it a release state (OFF state) (Step S23).
[0057] Next, operation of the driving gear of the hybrid vehicles of this invention is explained based on the timing diagram shown in drawing 8 . At time t1, it gets into an accelerator, accelerator opening changes to alpha 2 from alpha 1, and time t2 explains operation when accelerator opening changes from alpha 2 to alpha 1 as shown in drawing 8 . Here, you may be alpha1<20%, alpha 2>20%.
[0058] As for a generator 16, accelerator opening is fixed by engaging Brake B in the state of alpha 1 (ON state), the rotational frequency has become a zero state, and the generator torque TG also serves as zero. Moreover, it is the motor [torque / motor / TM] torque TM 1 according to the accelerator opening alpha 1. It has become.
[0059] time t1 the output torque corresponding to the accelerator opening alpha 2 when it set and accelerator opening changed from alpha 1 to alpha 2 -- it should output -- the motor torque TM -- TM1 from -- TM2 It goes up. Brake B is in ON state at this time (a dotted line A shows drawing 8 .). It is below the same.
[0060] In order for the engine 11 by release of Brake B to blow and to prevent a riser, generator torque is beforehand raised to generator torque TG* which becomes settled by the engine torque TE at that time. After becoming TG=TG*, in time t12, Brake B is taken off (OFF) and a generator raises the generator rotational frequency NG below by the rotational frequency rate of change defined beforehand simultaneously (dotted line B). In this operation gestalt, while ordering it target rotational frequency NG* of a generator 16, the generator torque TG is always computed and amendment torque deltaTM is added (dotted line C). For this reason, amendment torque deltaTM according to change of the generator torque TG is added to the motor torque TM as shown in drawing 8 (dotted line D).
[0061] The generator rotational frequency NG reaches target rotational frequency NG*, without going up rapidly (dotted line E). since there is no upheaval of the generator rotational frequency NG in the meantime -- an engine 11 -- blowing up -- etc. -- a bad influence called the aggravation of mpg and the increase in an exhaust gas to depend is not produced
[0062] the attainment, simultaneously the generator 16 to target rotational frequency NG* are controlled to hold target rotational frequency NG* Since elevation of the generator rotational frequency NG stops, the absolute value of the generator torque TG becomes larger than the time of the rotational frequency rising (dotted line F). If amendment torque deltaTM is added to the motor torque TM (dotted line G) and the generator rotational frequency NG also reaches target rotational frequency NG* in the meantime, since the absolute value of the generator torque TG will become large, the motor torque TM becomes small about it at an amendment sake (dotted line H).
[0063] When accelerator opening changes to alpha 1 from alpha 2, the motor torque TM is TM2 that the output torque according to the accelerator opening alpha 1 should be outputted. Shell TM 1 It descends. Brake B is in the OFF state at this time (dotted line I). Next, the generator torque TG is made to increase and amendment torque deltaTM according to change of the generator torque TG is simultaneously amended to the motor torque TM to make the generator rotational frequency NG into the zero which are a rotational frequency in a brake engagement state (ON) (dotted line J). When the generator rotational frequency NG descends, without changing rapidly (dotted line K) and it becomes small rather than deltaNG*, it is time t22 and Brake B is engaged (dotted line L). (ON) since there is no upheaval of the generator rotational frequency NG in the meantime -- an engine 11 -- blowing up -- etc. -- a bad

influence called the aggravation of mpg and the increase in an exhaust gas to depend is not produced
[0064] since, as for the motor torque TM, torque amendment is performed (dotted line M), maintenance of run feeling is achieved and the generator torque TG becomes small with engagement of Brake B, while the generator rotational frequency NG is descending -- the motor torque TM -- the part -- it becomes large -- it becomes (dotted line N) And when a generator 16 is completely fixed by Brake B, the generator torque TG serves as zero (dotted line O).
[0065] Although the above explanation explained the control action to which the accelerator opening alpha carries out engagement release of the brake B bordering on the state of being 20% In this invention, it is not what is limited to the above-mentioned operation. by manual operation It can apply, when switching to the mode it runs while generating run mode with a generator 16, and the mode it runs, without generating electricity with a generator 16. In addition, in order to make engine brake act, when it fixes Rota 21 of a generator 16 and fixes Rota 21 of a generator 16 during a run, it can use.
[0066] In addition, what kind of brake is sufficient as the brake B used in the operation gestalt which gave [above-mentioned] explanation. In this case, although any of a wet brake and a dry type brake are sufficient, it is desirable to use a wet brake at the point which is easy to control a rotational frequency.
[0067] The <2nd operation gestalt>, next the 2nd operation gestalt of this invention are explained. Drawing 9 is the conceptual diagram showing the composition of the driving gear of the 2nd operation gestalt. By the hybrid vehicles of this operation gestalt, in the planetary gear unit 13, the clutch C which is an engagement means is formed between Carrier CR and the sun gear S, and the brake B currently arranged by the generator 16 in the 1st operation gestalt is not formed. Moreover, as for Clutch C, engagement and release are controlled by the actuator by which an ON/OFF signal is supplied from the vehicles control unit 41. About other structures, since it is the same as that of the 1st operation gestalt, the same sign is given to the same composition as drawing 1 , and explanation is omitted.
[0068] Operation of the driving gear of the 2nd operation gestalt is explained. Clutch C is usually in the release state (OFF state) at the time of a run, and is made into an engagement state (ON state) at the time of acceleration.
[0069] Usually, by the time of a run, the planetary gear unit 13 has become open, and it is rotating at the rotational frequency of which Clutch C is canceled and from which a sun gear S, Carrier CR, and a starter ring R differ independently, respectively as shown in drawing 2 (B). With the **** 2 operation form, since the number of teeth of a starter ring R serves as double precision of a sun gear S, the gear ratio of an engine 11 to the unit output shaft 14 is two thirds.
[0070] And in the time of the acceleration run with which Clutch C is engaging, each gearing element of the planetary gear unit 13 is really rotated, and becomes the same [the rotational frequency of each gearing element]. The gear ratio of an engine 11 to the unit output shaft 14 at this time is set to 1, and the output transmitted to the unit output shaft 14 from an engine 11 increases by 1.5 times as compared with the time of Clutch C being in a release state. The output transmitted to the counter shaft 31 which is a drive output shaft by this increases, and acceleration is performed.
[0071] Next, the control action of the 2nd operation form is explained. Drawing 10 is a timing diagram which shows control action. Hereafter, from the state of alpha 1, it is made to increase to alpha 2 and accelerator opening is accelerated, and control action at the time of changing the accelerator opening after an acceleration end to alpha 3 is made into an example, and it explains.
[0072] Usually, in the run state, Clutch C is in the release state (OFF state) by alpha 1, and accelerator opening is set as the value [torque / motor / TM / the rotational frequency NG of a generator 16, Torque TG, and] corresponding to the accelerator opening alpha 1 and the vehicle speed V respectively.
[0073] time t1 the output torque corresponding to the accelerator opening alpha 2 in order to set and accelerate, when accelerator opening was made to increase to alpha 2 from alpha 1 -- it should output -- the motor torque TM -- TM1 from -- TM2 It goes up. Clutch C is in the OFF state at this time (a dotted line a shows drawing 8 .). It is below the same.
[0074] In order to consider as the output rotational frequency NOUT into which the generator rotational frequency NG is inputted by the generator 16 at the starter ring R, it is target rotational frequency NG*2. It is set as NOUT and the generator torque TG is decreased. Thereby, the generator rotational frequency

NG is target rotational frequency NG*2. It turns and begins (dotted line b) to increase. To the motor torque TM, amendment torque deltaTM according to change of the generator torque TG is amended simultaneously (dotted line c). The generator rotational frequency NG rises, without changing rapidly (dotted line d), and is the real rotational frequency NG and target rotational frequency NG*2. When a difference becomes smaller than deltaNG*, it is time t12 and Clutch C is engaged (dotted line g). (ON) Here, deltaNG* is the real rotational frequency NG at the time of being the value set up in the range which does not enlarge consumption of the friction material of Clutch C and does not tell an operator a shock, and making Clutch C engaged, and target rotational frequency NG*2. It is the allowed value of a difference.

[0075] Time t2 If it sets, and an acceleration run is completed, accelerator opening is decreased from alpha 2 to alpha 3 and it is usually a run, the motor torque TM will be decreased according to the accelerator opening alpha (dotted line j). Moreover, in order for the engine 11 by canceling Clutch C in the state where torque is not added to a generator 16 to blow and to suppress a riser, it asks for generator torque TG* which becomes settled by the engine torque TE at that time, and generator torque is beforehand raised to TG* (dotted line i).

[0076] It is target rotational frequency NG*3 so that Clutch C may be canceled in time t22 after becoming TG=TG* (OFF), and the generator rotational frequency NG may not exceed the upper limit of rotational frequency rate of change simultaneously. It turns and begins (dotted line k) to descend. Moreover, amendment torque deltaTM according to change of the generator torque TG is added to the motor torque TM (dotted line m). The generator rotational frequency NG is target rotational frequency NG*3, without descending rapidly (dotted line n). It reaches.

[0077] In addition, although any of a wet clutch and a dry clutch are sufficient as the clutch C used in the operation form which gave [above-mentioned] explanation, it is desirable to use a wet clutch at the point which can mitigate the shock at the time of engagement. By using a wet clutch, the shock at the time of clutch C engagement can be suppressed further.

[0078] Moreover, the clutch C which is the above-mentioned engagement means may be formed between the sun gear S which is the 2nd gearing element, and the starter ring R which is the 3rd gearing element, and may be prepared between Carrier CR and the starter ring R. The control method of the generator rotational frequency NG in this case is the same as that of the case of the above-mentioned 2nd operation form.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the conceptual diagram showing the driving gear of the hybrid vehicles in the 1st operation gestalt of this invention.
[Drawing 2] It is the conceptual diagram and velocity diagram of a planetary gear unit in the 1st operation gestalt of this invention.
[Drawing 3] It is the torque diagram of the planetary gear unit in the 1st operation gestalt of this invention.
[Drawing 4] It is the block diagram showing the composition of the control system in the 1st operation gestalt of this invention.
[Drawing 5] It is explanatory drawing showing the relation of the target rotational frequency of hybrid vehicles and throttle opening in the 1st operation gestalt of this invention.
[Drawing 6] It is the flow chart which shows the control action of the vehicles control unit in the 1st operation gestalt of this invention.
[Drawing 7] It is explanatory drawing showing the relation of the upper limit rate of change of a generator rotational frequency and accelerator opening in the 1st operation gestalt of this invention.
[Drawing 8] It is the timing diagram which shows the control action of the vehicles control unit in the 1st operation gestalt of this invention.
[Drawing 9] It is the conceptual diagram showing the driving gear of the hybrid vehicles in the 2nd operation gestalt of this invention.
[Drawing 10] It is the timing diagram which shows the control action of the vehicles control unit in the 2nd operation gestalt of this invention.
[Description of Notations]
11 Engine
13 Planetary Gear Unit (Differential Gear Mechanism)
16 Generator
21 Rota
25 Electric Motor
31 Counter Shaft (Drive Output Shaft)
41 Vehicles Control Unit
42 Engine Control System
43 Motor Control Equipment
44 Arrangement for Controlling Electric Generator
45 Accelerator Sensor
46 Vehicle Speed Sensor
54 Electro-magnetic Valve
B Brake (engagement means)
C Clutch (engagement means)
CR Carrier (the 1st gearing element)

S Sun gear (the 2nd gearing element)
R Starter ring (the 3rd gearing element)

[Translation done.]

* NOTICES *

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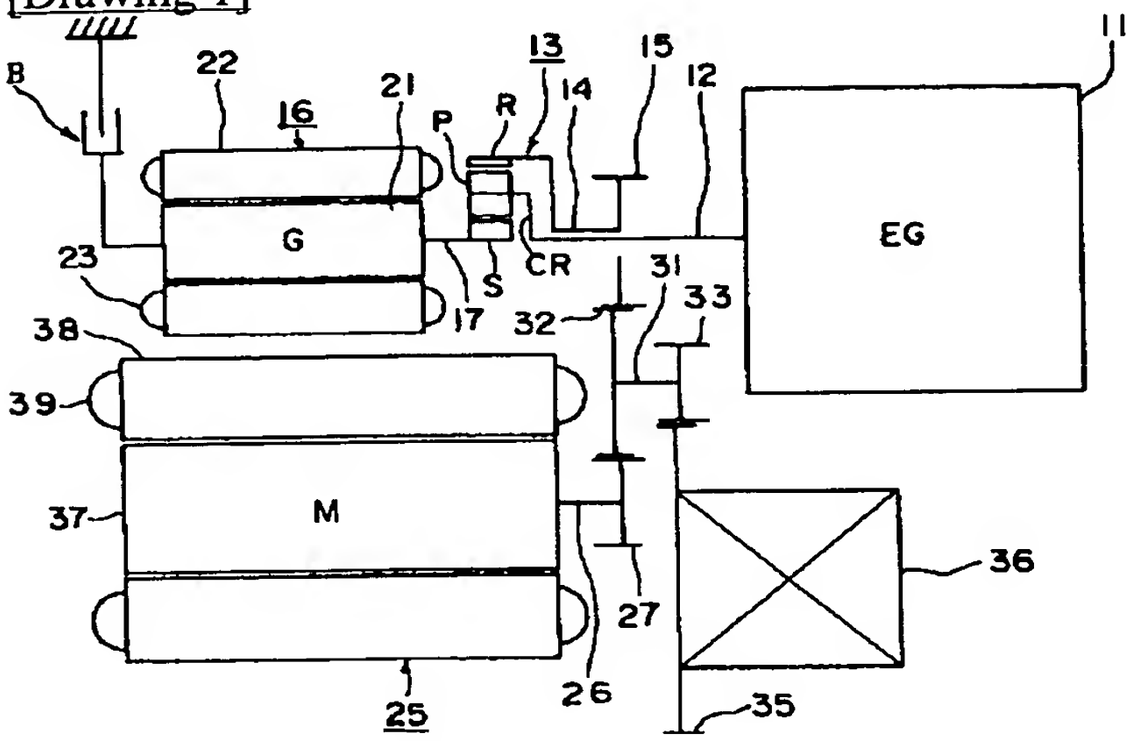
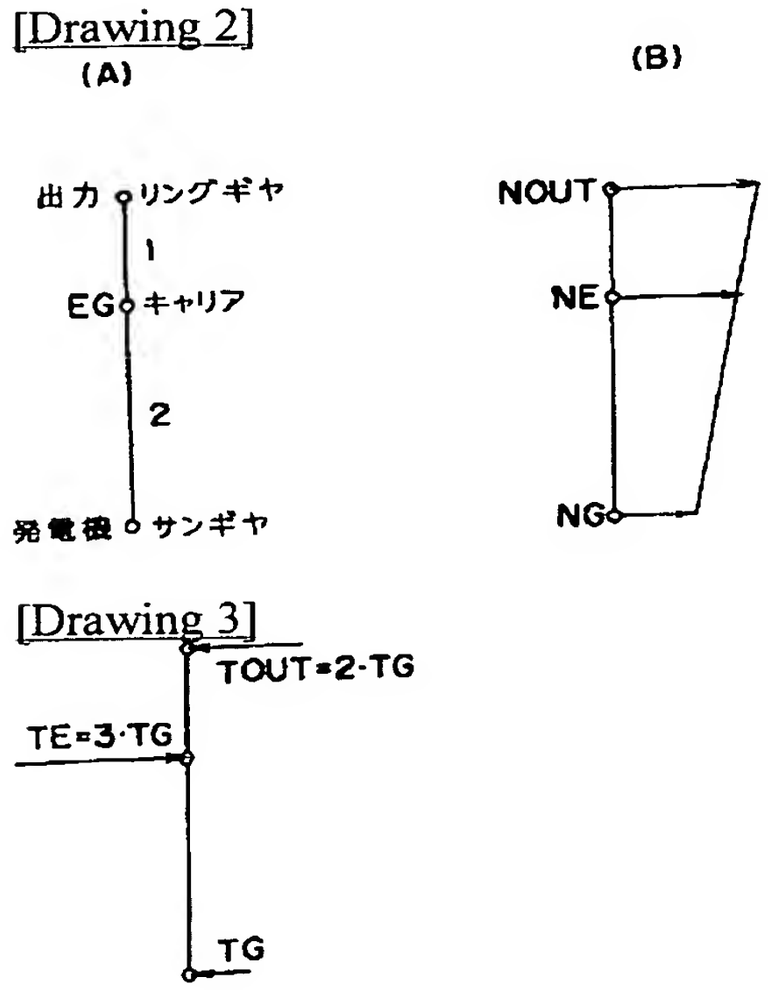
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]

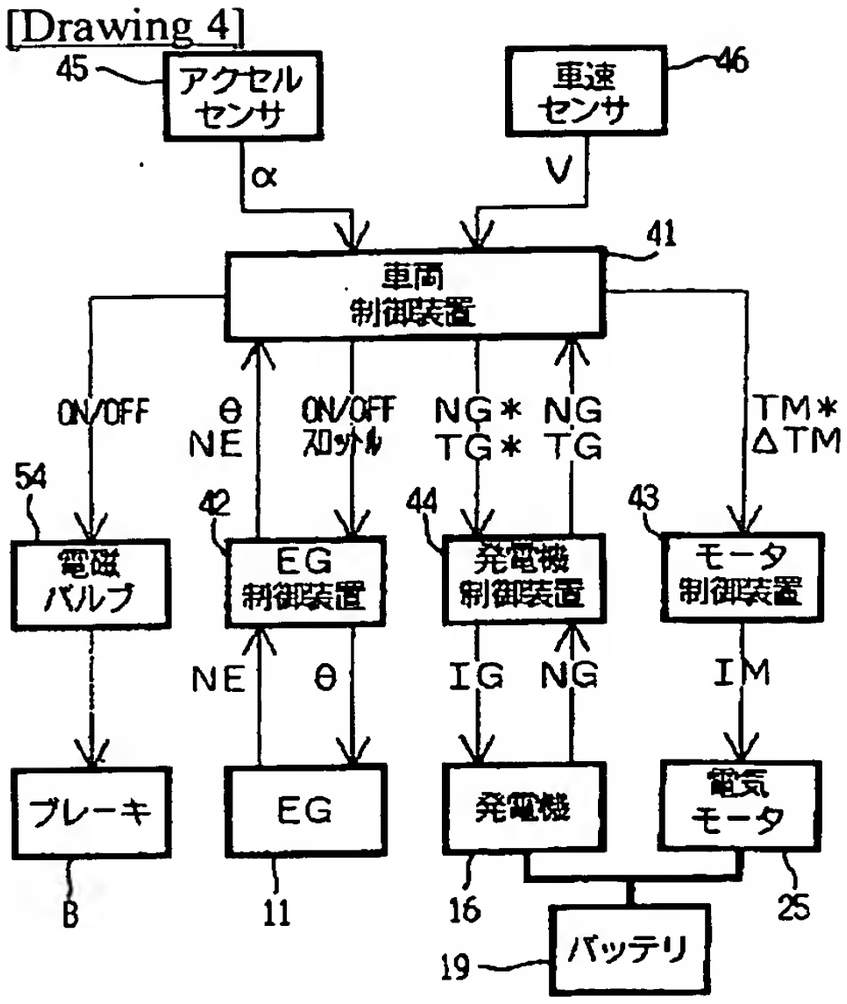


[Drawing 2]



[Drawing 3]

[Drawing 4]



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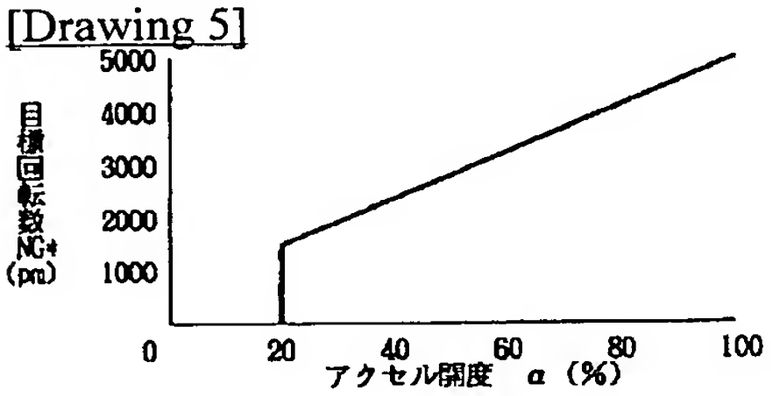
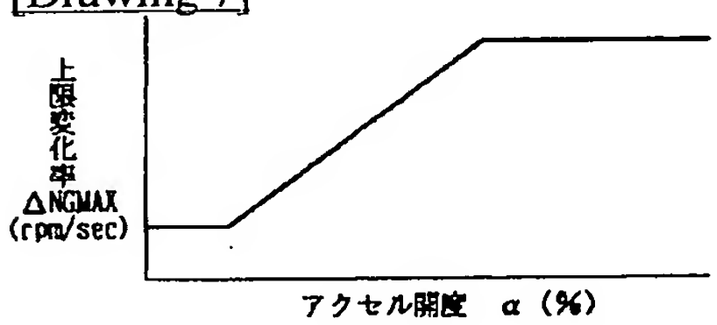
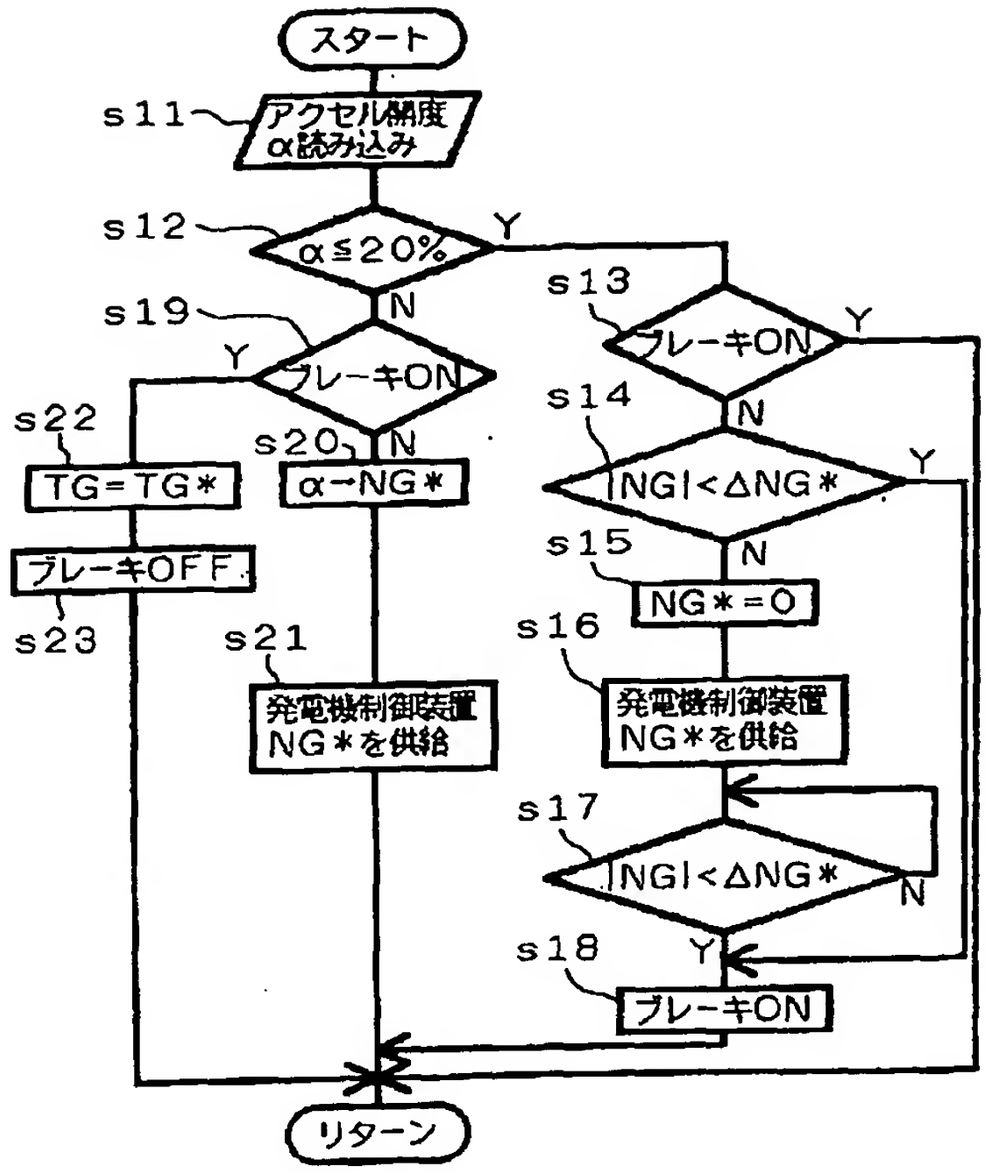


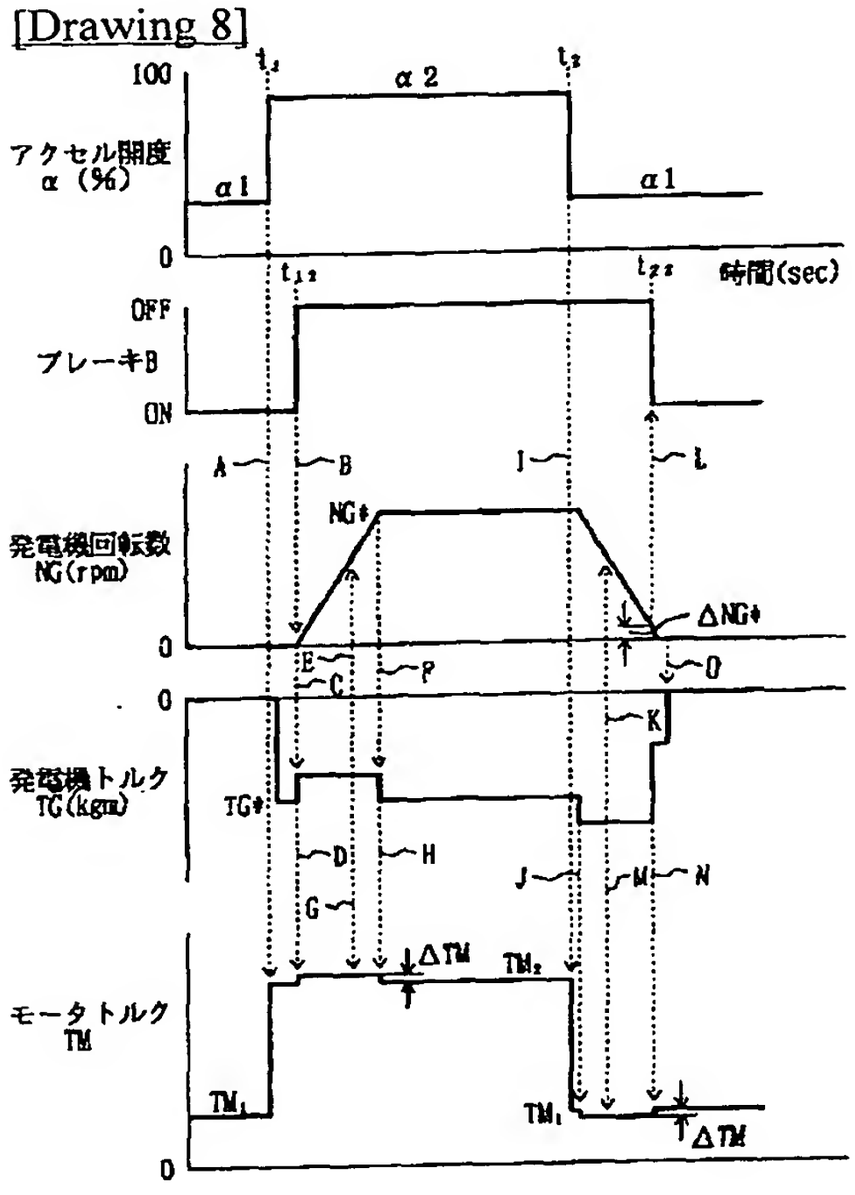
[Drawing 7]



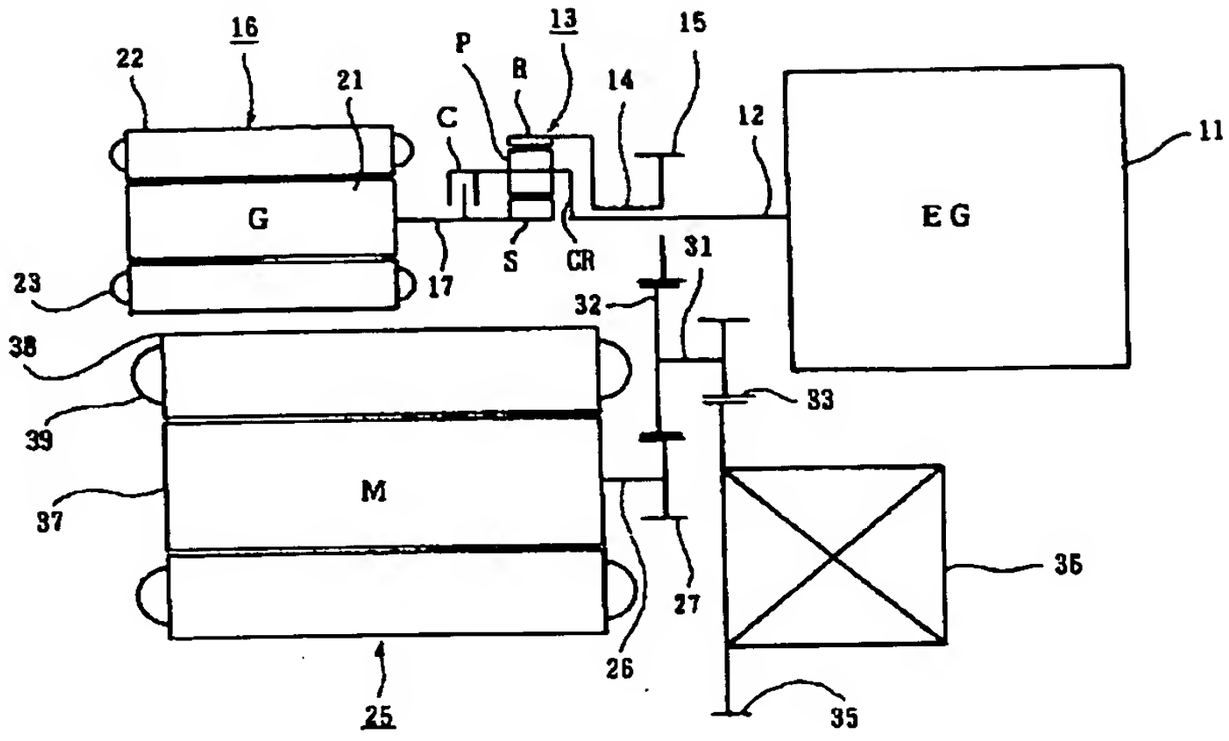
[Drawing 6]



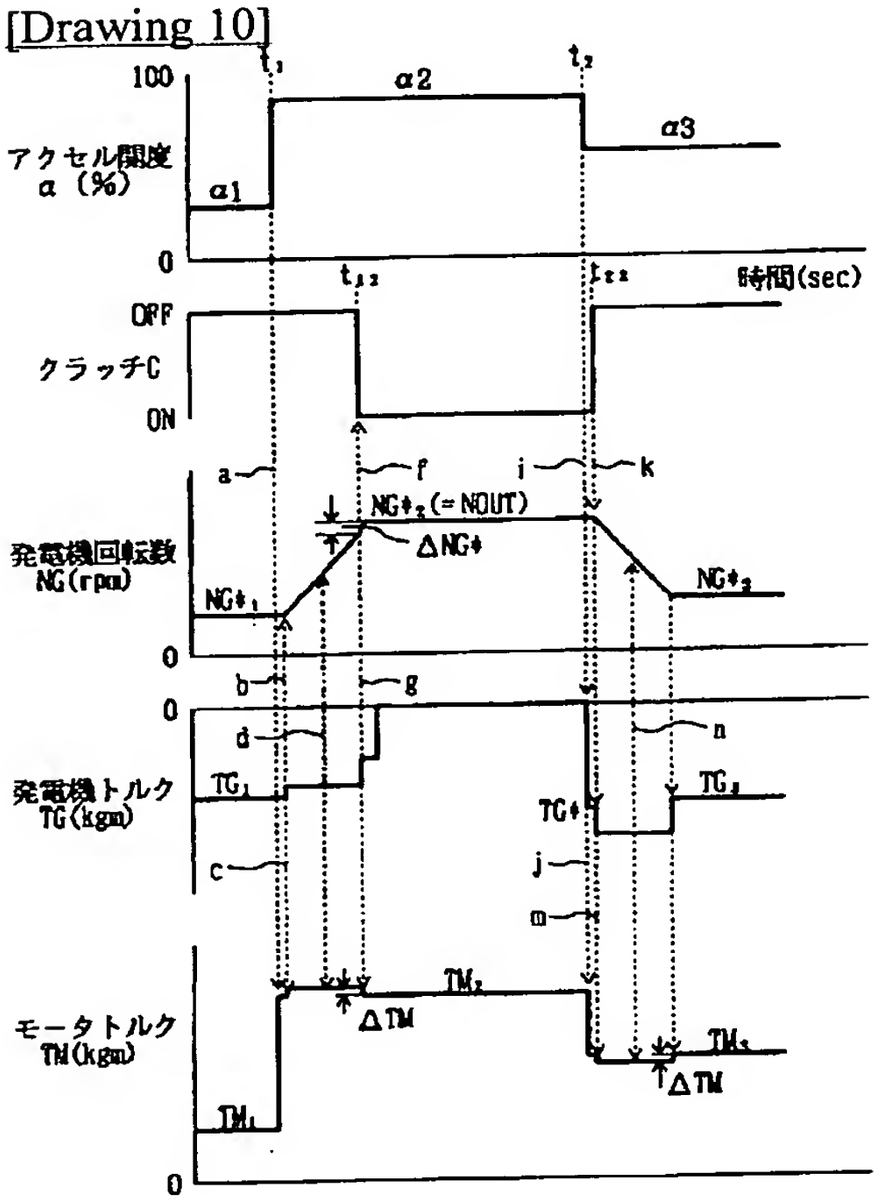
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]

* NOTICES *

CORRECTION or AMENDMENT

[Official Gazette Type] Printing of amendment by the convention of 2 of Article 17 of patent law.
[Section partition] The 5th partition of the 2nd section.
[Date of issue] November 2, Heisei 11 (1999).

[Publication No.] Publication number 9-156387.
[Date of Publication] June 17, Heisei 9 (1997).
[**** format] Open patent official report 9-1564.
[Filing Number] Japanese Patent Application No. 7-344542.
[International Patent Classification (6th Edition)]

B60K	17/04	.
B60L	11/14	.
H02P	9/04	.

[FI]

B60K	17/04	G	.
B60L	11/14		.
H02P	9/04	L	.

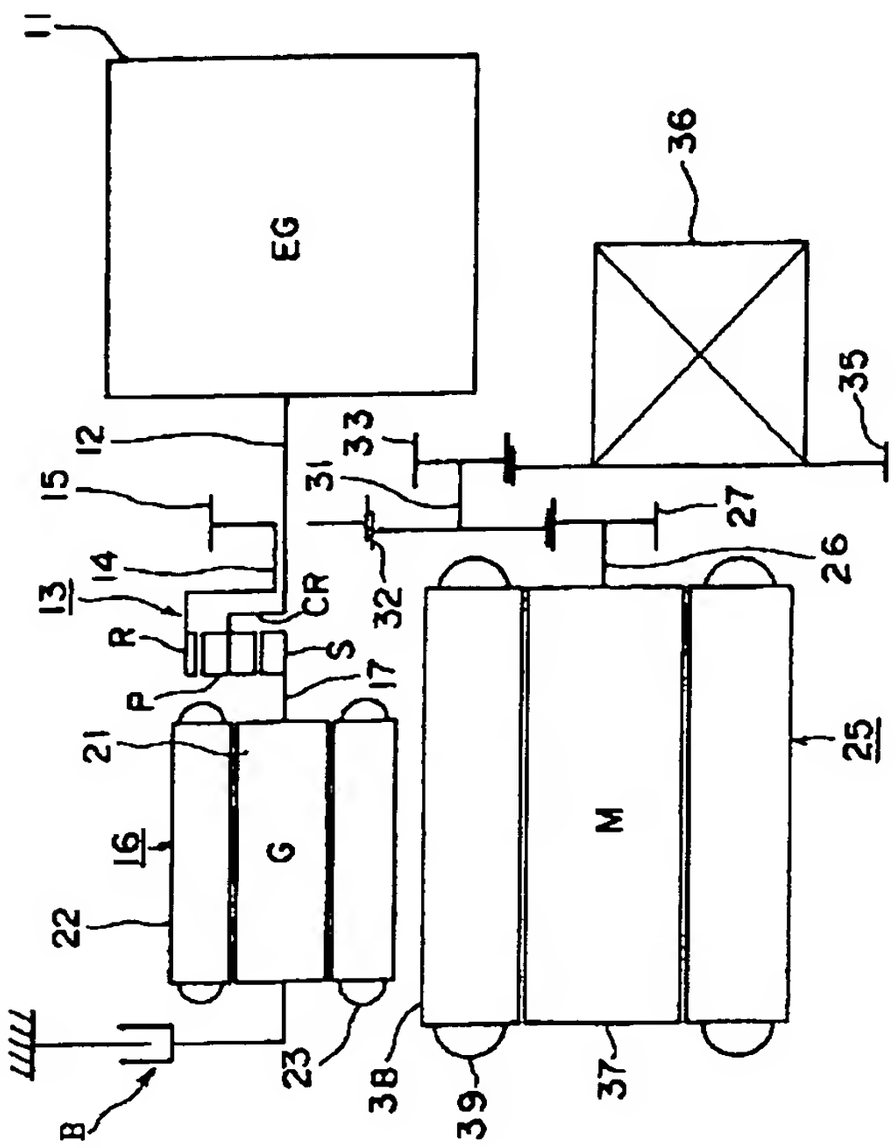
[Procedure revision]
[Filing Date] February 9, Heisei 11.
[Procedure amendment 1]
[Document to be Amended] Specification.
[Item(s) to be Amended] Claim.
[Method of Amendment] Change.
[Proposed Amendment]
[Claim(s)]
[Claim 1] Engine,
The generator in which revolving speed control is possible,
The drive output shaft which transmits driving force to a driving wheel,
The electric motor connected with the aforementioned drive output shaft,
The differential gear mechanism with which the 1st gearing element was connected with the output shaft of the aforementioned engine, the 2nd gearing element was connected with Rota of the aforementioned generator, and the 3rd gearing element was connected with the aforementioned drive output shaft,
The engagement means arranged between Rota of the aforementioned generator, and the stop member,
Generator control means which control the rotational frequency of the aforementioned generator,
The hybrid vehicles characterized by having the engagement control means which make the aforementioned engagement means an engagement state when the relative rotational frequency of the

Rota and the aforementioned stop member which were controlled by the aforementioned generator control means becomes within limits defined beforehand.
[Claim 2] The aforementioned stop members are hybrid vehicles according to claim 1 which are the cases which fix Rota of the aforementioned generator.
[Claim 3] The aforementioned stop members are hybrid vehicles according to claim 1 which are either among the gearing element of the above 1st, and the gearing element of the above 3rd.
[Claim 4] The aforementioned generator control means are hybrid vehicles according to claim 1 to 3 which control the rate of change of the rotational frequency of the aforementioned generator within limits which were able to be defined beforehand.
[Procedure amendment 2]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0009.
[Method of Amendment] Change.
[Proposed Amendment]
[0009] The hybrid vehicles characterized by providing the following. (1) Engine. The generator in which revolving speed control is possible. The drive output shaft which transmits driving force to a driving wheel. The electric motor connected with the aforementioned drive output shaft, and the differential gear mechanism with which the 1st gearing element was connected with the output shaft of the aforementioned engine, the 2nd gearing element was connected with Rota of the aforementioned generator, and the 3rd gearing element was connected with the aforementioned drive output shaft, The engagement means arranged between Rota of the aforementioned generator, and the stop member, and the generator control means which control the rotational frequency of the aforementioned generator, Engagement control means which make the aforementioned engagement means an engagement state when the relative rotational frequency of the Rota and the aforementioned stop member which were controlled by the aforementioned generator control means becomes within limits defined beforehand.
[Procedure amendment 3]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0012.
[Method of Amendment] Deletion.
[Procedure amendment 4]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0013.
[Method of Amendment] Change.
[Proposed Amendment]
[0013] (4) The aforementioned generator control means are hybrid vehicles the above (1) which controls the rate of change of the rotational frequency of the aforementioned generator within limits which were able to be defined beforehand, or given in either of (3).
[Procedure amendment 5]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0032.
[Method of Amendment] Change.
[Proposed Amendment]
[0032] It becomes. moreover, when torque (henceforth "starter-ring torque") outputted to the unit output shaft 14 from a starter ring R is set to TR (=TOUT), torque (henceforth a "engine torque") of an engine 11 is set to TE and generator torque is set to TG, the relation of TR, TE, and TG is shown in drawing 3 -- as
[Procedure amendment 6]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0037.
[Method of Amendment] Change.
[Proposed Amendment]

[0037] Next, the control system of the hybrid vehicles of this invention is explained in detail based on the block diagram of drawing 4. The control means which constitute the control system of this operation gestalt have the vehicles control unit 41, an engine control system 42, motor control equipment 43, and arrangement for controlling electric generator 44. The microcomputer equipped with ROM (read-only memory) in which CPU (central processing unit), and various programs and data were stored, RAM (random access memory) used as a working area can constitute these control units 41, 42, 43, and 44.
[Procedure amendment 7]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0076.
[Method of Amendment] Change.
[Proposed Amendment]
[0076] After becoming TG=TG*, in time t22, Clutch C is canceled (OFF), and the generator rotational frequency NG begins (dotted line k) to descend towards target rotational frequency NG*3 simultaneously so that the upper limit of rotational frequency rate of change may not be exceeded. Moreover, amendment torque deltaTM according to change of the generator torque TG is added to the motor torque TM (dotted line m). The generator rotational frequency NG reaches target rotational frequency NG*3, without descending rapidly (dotted line n). As mentioned above, if the rotational frequency of a generator is controlled by generator control means, the output torque outputted to a drive output shaft through a differential gear mechanism will be changed. the motor output torque of the electric motor connected with the drive output shaft here -- a torque amendment means -- change of an output torque -- responding -- an amendment -- engagement of an engagement means can be performed by things, without spoiling run feeling Since motor torque is amended and torque change produced at the time of generator revolving speed control is absorbed, run feeling is maintainable in the good state.
[Procedure amendment 8]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0082.
[Method of Amendment] Deletion.
[Procedure amendment 9]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0083.
[Method of Amendment] Change.
[Proposed Amendment]
[0083] By controlling the rate of change of a generator rotational frequency within limits which were able to be defined beforehand, the abrupt change of a generator rotational frequency is suppressed and invention according to claim 4 can lessen the bad influence to mpg, the amount of exhaust gas, etc. of an engine.

[Translation done.]

Drawing selection [Representative drawing]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)**公開特許公報**（A）　(11)特許出願公開番号

特開平9－156387

(43)公開日　平成９年(1997)６月17日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ		技術表示箇所
Ｂ６０Ｋ　17/04			Ｂ６０Ｋ　17/04		G
Ｂ６０Ｌ　11/14			Ｂ６０Ｌ　11/14		
Ｈ０２Ｐ　9/04			Ｈ０２Ｐ　9/04		L

審査請求　未請求　請求項の数５　ＦＤ　（全 11 頁）

(21)出願番号　特願平7－344542

(22)出願日　平成７年(1995)12月５日

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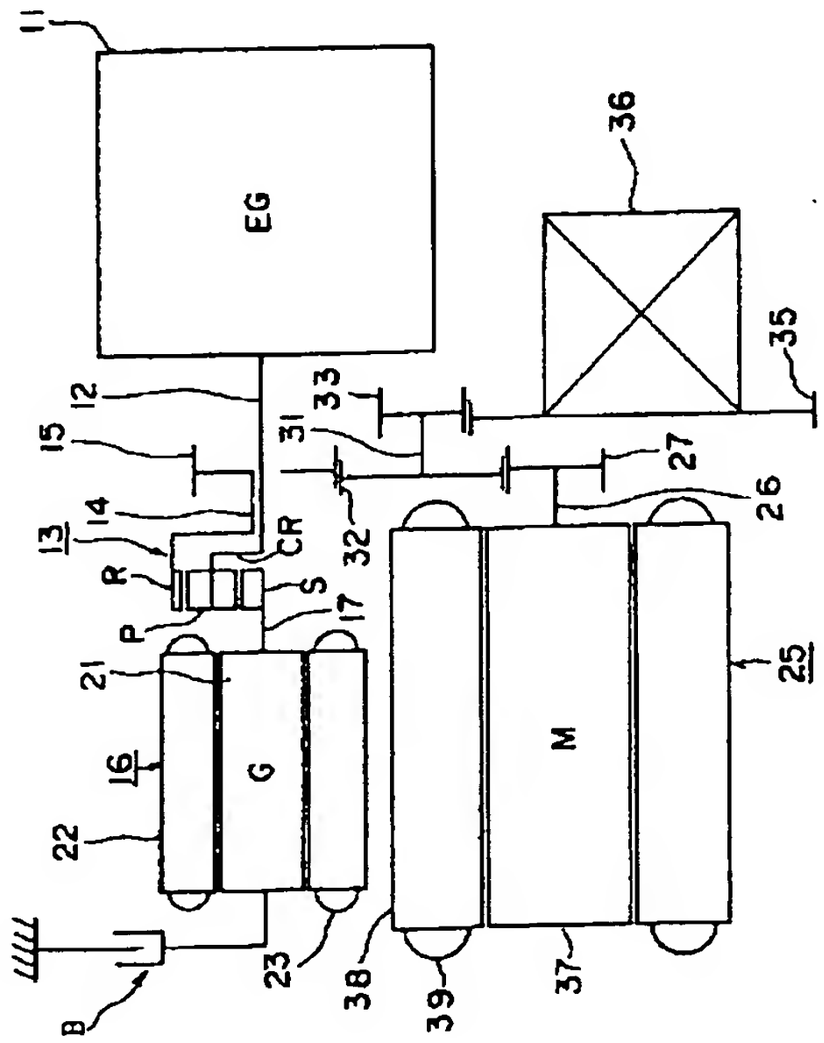
(54)【発明の名称】　ハイブリッド車両

(57)【要約】
【課題】発電機に設けられたブレーキの係合ショックの軽減を図る。
【解決手段】エンジン１１と発電機１６と駆動出力軸３１とをプラネタリギヤユニット１３の各歯車要素に連結し、駆動出力軸３１に連結された電気モータ２５の出力とエンジン出力によって走行するハイブリッド車両において、ブレーキＢによって発電機１６を停止した非発電機モードと、ブレーキＢを解除した発電モードとに切換走行可能な構成とし、発電機回転数をゼロに近づけてからブレーキＢを係合することで、係合時ショックの軽減を図る。同時に、発電機回転数制御時のトルク変動を補正するために電気モータ２５の出力トルクを調整し、かつ発電機回転数の変化率に上限を設けて、エンジン１１への悪影響を少なくした。



1

【特許請求の範囲】
【請求項１】　エンジンと、
回転数制御可能な発電機と、
駆動輪の駆動力を出力する駆動出力軸と、
第１の歯車要素が前記エンジンの出力軸に連結され、第２の歯車要素が前記発電機のロータに連結され、第３の歯車要素が前記駆動出力軸に連結された差動歯車装置と、
前記駆動出力軸に連結された電気モータと、
前記発電機のロータと係止部材との間に配設された係合手段と、
前記発電機の回転数を制御する発電機制御手段と、
前記発電機制御手段によって制御されたロータと前記係止部材との相対回転数が、予め定められた範囲内になった時に、前記係合手段を係合状態とする係合制御手段とを備えることを特徴とするハイブリッド車両。
【請求項２】　前記係止部材は、前記発電機のロータを固定するケースである請求項１に記載のハイブリッド車両。
【請求項３】　前記係止部材は、前記第１の歯車要素と前記第３の歯車要素の内いずれか一方である請求項１に記載のハイブリッド車両。
【請求項４】　さらに、前記発電機制御手段による回転数制御によって生ずるトルク変動に応じて、前記電気モータのモータ出力トルクを補正するトルク補正手段を有する請求項１ないし３のいずれかに記載のハイブリッド車両。
【請求項５】　前記発電機制御手段は、前記発電機の回転数の変化率を予め定められた範囲内に制御する請求項１ないし４のいずれかに記載のハイブリッド車両。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、エンジンとモータとを駆動源として走行するハイブリッド車両に関するものである。
【０００２】
【従来の技術】従来、低公害、低燃費を実現するために、エンジンとモータとを併用した駆動装置を有するハイブリッド車両が提案されており、例えば、米国特許第３５６６７１７号は、差動歯車装置を用いて発電機とエンジンが連結され、エンジンからの出力の一部を発電に用い、残りを直接駆動出力軸に出力する。このようなハイブリッド車両では、発電機の回転を制御することによって、走行モードをエンジン・モータ駆動モードや、モータ駆動モードなどに切り替えることができ、さらには、回生電力のバッテリーへの充電や、エンジンの始動を行うことができる。
【０００３】
【発明が解決しようとする課題】一方、上記ハイブリッド車両においては、差動歯車装置を介して、エンジン、

2

発電機、駆動モータが接続されており、それぞれの回転数やトルクが相互に関連するため、例えばエンジンブレーキを効かせることなどを目的として、発電機に設けられたブレーキを作用させ、発電機の回転を固定する場合がある。
【０００４】ここで、ブレーキによって発電機の回転数を突然止めてしまうと、衝撃が大きくなり、走行感覚が損なわれる恐れがあり、また、ブレーキの摩擦材が発熱によって著しく消耗する。
【０００５】このような衝撃を吸収するために、例えばアキュムレータのようなショック吸収装置を設けると、オリフィスやアキュムレータ・スプリングなどの調整を、車毎に行う必要があり、製造やメンテナンスに手間がかかるといった問題が生ずる。また、摩擦材の摩擦係数の経時変化や、運転状態、温度などに影響されて、アキュムレータのショック吸収効果を安定して維持することが難しく、期待した効果が得られない場合が多い。
【０００６】さらに、上記ショック吸収装置を取り付けると機構が複雑となり、搭載スペースの少ない電気自動車には好ましくない構成となる。
【０００７】本発明の目的は、発電機回転数を予め制御することによって、係合手段の係合時の衝撃を抑制したハイブリッド車両を提供することにある。
【０００８】
【課題を解決するための手段】このような目的は、以下の本発明によって達成される。
【０００９】（１）　エンジンと、回転数制御可能な発電機と、駆動輪の駆動力を出力する駆動出力軸と、第１の歯車要素が前記エンジンの出力軸に連結され、第２の歯車要素が前記発電機のロータに連結され、第３の歯車要素が前記駆動出力軸に連結された差動歯車装置と、前記駆動出力軸に連結された電気モータと、前記発電機のロータと係止部材との間に配設された係合手段と、前記発電機の回転数を制御する発電機制御手段と、前記発電機制御手段によって制御されたロータと前記係止部材との相対回転数が、予め定められた範囲内になった時に、前記係合手段を係合状態とする係合制御手段とを備えることを特徴とするハイブリッド車両。
【００１０】（２）　前記係止部材は、前記発電機のロータを固定するケースである上記（１）に記載のハイブリッド車両。
【００１１】（３）　前記係止部材は、前記第１の歯車要素と前記第３の歯車要素の内いずれか一方である上記（１）に記載のハイブリッド車両。
【００１２】（４）　さらに、前記発電機制御手段による回転数制御によって生ずるトルク変動に応じて、前記電気モータのモータ出力トルクを補正するトルク補正手段を有する上記（１）ないし（３）のいずれかに記載のハイブリッド車両。
【００１３】（５）　前記発電機制御手段は、前記発電

機の回転数の変化率を予め定められた範囲内に制御する上記（１）ないし（４）のいずれかに記載のハイブリッド車両。

【００１４】

【作用】発電機の回転数を発電機制御手段によって制御し、係合手段によって係合状態となった時の回転数まで回転数を落とした後、係合制御手段によって係合手段を係合状態とする。これにより、係合手段を係合させる前と、係合させた後との間で、発電機の回転数の差が少ないので、係合手段による係合時のショックが抑制される。

【００１５】係止部材がケースである場合には、発電機制御手段は、発電機の回転数がゼロとなるように発電機の回転数を制御し、係合手段が係合される。係止部材が第１の歯車要素または第３の歯車要素である場合には、発電機のロータに接続された第２の歯車要素の回転数が、他の第１の歯車要素または第３の歯車要素の回転数と同じになった時に、係合手段を係合させる。これにより、第１の歯車要素、第２の歯車要素および第３の歯車要素は一体として回転する。

【００１６】発電機制御手段によって発電機の回転数を制御すると、差動歯車装置から駆動出力軸に出力される出力トルクが変動する。ここで、駆動出力軸に連結されている電気モータのモータ出力トルクを、トルク補正手段により、出力トルクの変動に応じて補正することにより、走行感覚を損なうことなく、係合手段の係合ができる。

【００１７】発電機制御手段によって発電機の回転数を、係合手段の係合時の回転数へ変化させる時には、回転数の変化率が大き過ぎると、エンジンの吹き上がりや、係合時のショックと同様の衝撃が生ずる可能性があるため、回転数の変化率が予め定められた範囲内を越えないように制御される。

【００１８】

【発明の実施の形態】

＜第１実施形態＞以下、本発明のハイブリッド車両の第１実施形態について、添付図面に基づいて詳細に説明する。

【００１９】図１は、本発明の第１実施形態のハイブリッド車両の駆動装置を示す概念図である。図において、第１軸線上には、エンジン１１と、エンジン１１を駆動させることによって発生する回転を出力するエンジン出力軸１２と、該エンジン出力軸１２を介して入力された回転に対して変速を行う差動歯車装置であるプラネタリギヤユニット１３と、該プラネタリギヤユニット１３における変速後の回転が出力されるユニット出力軸１４と、該ユニット出力軸１４に固定された第１カウンタドライブギヤ１５と、通常走行状態では主として発電機として作用する発電機１６と、該発電機１６とプラネタリギヤユニット１３とを連結する伝達軸１７とが配置されている。ユニット出力軸１４は、スリーブ形状を有し、エンジン出力軸１２を包囲して配設されている。また、第１カウンタドライブギヤ１５は、プラネタリギヤユニット１３よりエンジン１１側に配設されている。

【００２０】プラネタリギヤユニット１３は、第２の歯車要素であるサンギヤＳと、サンギヤＳと噛合するピニオンＰと、該ピニオンＰと噛合する第３の歯車要素であるリングギヤＲと、ピニオンＰを回転自在に支持する第１の歯車要素であるキャリヤＣＲとを備えている。

【００２１】サンギヤＳは、伝達軸１７を介して発電機１６と連結され、リングギヤＲは、ユニット出力軸１４を介して第１カウンタドライブギヤ１５と連結され、キャリヤＣＲは、エンジン出力軸１２を介してエンジン１１と連結されている。

【００２２】さらに、発電機１６は伝達軸１７に固定され、回転自在に配設されたロータ２１と、該ロータ２１の周囲に配設されたステータ２２と、該ステータ２２に巻装されたコイル２３とを備えている。発電機１６は、伝達軸１７を介して伝達される回転によって電力を発生させる。前記コイル２３は図示しないバッテリに接続され、該バッテリに電力を供給して充電する。

【００２３】発電機１６には、伝達軸１７の他端側に、係合手段であるブレーキＢが接続されており、このブレーキＢを係合状態とすることで、ロータ２１が固定され、発電機１６の回転およびサンギヤＳの回転が停止されるようになっている。第１軸線と平行な第２軸線上には、電気モータ２５と、電気モータ２５の回転が出力されるモータ出力軸２６と、モータ出力軸２６に固定された第２カウンタドライブギヤ２７とが配置されている。

【００２４】電気モータ２５は、モータ出力軸２６に固定され、回転自在に配設されたロータ３７と、該ロータ３７の周囲に配設されたステータ３８と、該ステータ３８に巻装されたコイル３９とを備えている。電気モータ２５は、コイル３９に供給される電流によってトルクを発生させる。そのために、コイル３９は図示しないバッテリに接続され、該バッテリから電流が供給されるように構成されている。

【００２５】本発明のハイブリッド車両が減速状態において、電気モータ２５は、図示しない駆動輪から回転を受けて回生電力を発生させ、該回生電力をバッテリに供給して充電する。そして、前記エンジン１１の回転と同じ方向に図示しない駆動輪を回転させるために、第１軸線及び第２軸線と平行な第３軸線上には、駆動出力軸としてカウンタシャフト３１が配設されている。該カウンタシャフト３１にはカウンタドリブンギヤ３２が固定されている。

【００２６】また、該カウンタドリブンギヤ３２と第１カウンタドライブギヤ１５とが、及びカウンタドリブンギヤ３２と第２カウンタドライブギヤ２７とが噛合させられ、第１カウンタドライブギヤ１５の回転及び第２カ

ウンタドライブギヤ２７の回転が反転されてカウンタドリブンギヤ３２に伝達されるようになっている。

【００２７】さらに、カウンタシャフト３１には、カウンタドリブンギヤ３２より歯数が小さなデフピニオンギヤ３３が固定される。そして、第１軸線、第２軸線及び第３軸線に平行な第４軸線上にデフリングギヤ３５が配設され、該デフリングギヤ３５と前記デフピニオンギヤ３３とが噛合させられる。また、前記デフリングギヤ３５にディファレンシャル装置３６が固定され、デフリングギヤ３５に伝達された回転が前記ディファレンシャル装置３６によって差動させられ、駆動輪に伝達される。上記構成において、駆動出力系は、プラネタリギヤユニット１３と、発電機１６と、第１カウンタドライブギヤ１５と、カウンタドリブンギヤ３２と、第２カウンタドライブギヤ２７と、カウンタシャフト３１と、デフピニオンギヤ３３と、デフリングギヤ３５と、ディファレンシャル装置３６とによって構成されている。

【００２８】このように、エンジン１１によって発生させられた回転をカウンタドリブンギヤ３２に伝達することができるだけでなく、電気モータ２５によって発生させられた回転をカウンタドリブンギヤ３２に伝達することができるので、エンジン１１だけを駆動するエンジン駆動モード、電気モータ２５だけを駆動するモータ駆動モード、並びにエンジン１１及び電気モータ２５を駆動するエンジン・モータ駆動モードでハイブリッド車両を走行させることができる。また、発電機１６において発生させられる電力を制御することによって、前記伝達軸１７の回転数を制御することができる。また、発電機の回転を停止させる場合には、ブレーキＢを係合させて発電機１６のロータ２１を固定することができる。この場合、ブレーキＢを係合解除することによって、ブレーキ解除状態では発電機１６で発電しながら走行するモードとし、ブレーキ係合状態では発電機１６で発電せずに走行するモードとすることができる。

【００２９】上記構成のハイブリッド車両のプラネタリギヤユニット１３の動作について説明する。図２（Ａ）は、本発明の第１実施形態のプラネタリギヤユニット１３（図１）の概念図、図２（Ｂ）は、本発明の第１実施形態におけるプラネタリギヤユニット１３の通常走行時の速度線図、図３は、本発明の第１実施形態におけるプラネタリギヤユニット１３の通常走行時のトルク線図である。

【００３０】本実施形態においては、図２（Ａ）に示されているように、プラネタリギヤユニット１３のリングギヤＲの歯数がサンギヤＳの歯数の２倍となっている。従って、リングギヤＲに接続されるユニット出力軸１４の回転数（以下「リングギヤ回転数」という。）をＮＲとし、キャリヤＣＲに接続されるエンジン出力軸１２の回転数（以下「エンジン回転数」という。）をＮＥとし、サンギヤＳに接続される伝達軸１７の回転数（以下

「発電機回転数」という。）をＮＧとした時、ＮＲ、ＮＥ、ＮＧの関係は、図２（Ｂ）に示されているように、

【００３１】ＮＧ＝３・ＮＥ－２・ＮＲ

【００３２】となる。また、リングギヤＲからユニット出力軸１４に出力されるトルク（以下「リングギヤトルク」という。）をＴＲとし、エンジン１１のトルク（以下「エンジントルク」という。）をＴＥとし、発電機トルクをＴＧとしたとき、ＴＲ、ＴＥ、ＴＧの関係は、図３に示されているように、

【００３３】ＴＥ：ＴＲ：ＴＧ＝３：２：１となる。

【００３４】そして、ハイブリッド車両の通常走行時においては、リングギヤＲ、キャリヤＣＲおよびサンギヤＳは、いずれも正方向に回転させられ、図２（Ｂ）に示されるように、リングギヤ回転数ＮＲ（＝出力回転数ＮＯＵＴ）、エンジンの回転数ＮＥ、発電機回転数ＮＧは、いずれも正の値を採る。

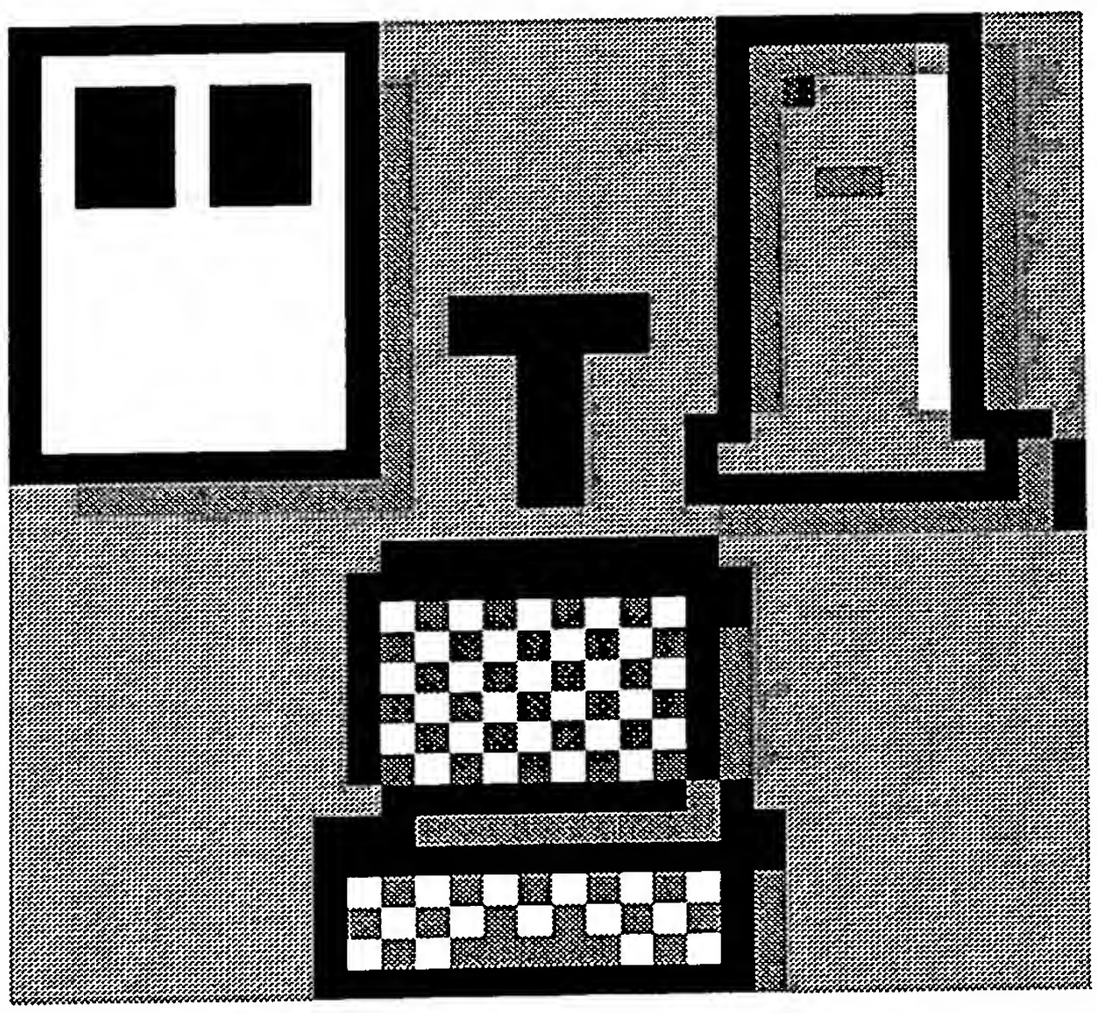
【００３５】そして、エンジントルクＴＥが、キャリヤＣＲに入力され、このエンジントルクＴＥが、図１に示されている第１カウンタドライブギヤ１５および発電機１６の反力によって受けられる。その結果、図３に示されているように、リングギヤＲからユニット出力軸１４にリングギヤトルクＴＲが、サンギヤＳから伝達軸１７に発電機トルクＴＧが出力される。

【００３６】上記リングギヤトルクＴＲおよび発電機トルクＴＧは、プラネタリギヤユニット１３の歯数によって決定されるトルク比でエンジントルクＴＥを按分することによって得られ、トルク線図上において、リングギヤトルクＴＲと発電機トルクＴＧとを加えたものがエンジントルクＴＥとなる。

【００３７】次に、本発明のハイブリッド車両の制御系について、図４のブロック図に基づいて詳細に説明する。本実施形態の制御系を構成する制御手段は、車両制御装置４１と、エンジン制御装置４２と、モータ制御装置４３と、発電機制御装置４４とを有している。これらの制御装置４１、４２、４３、４４は、例えばＣＰＵ（中央処理装置）、各種プログラムやデータが格納されたＲＯＭ（リード・オン・メモリ）、ワーキングエリアとして使用されるＲＡＭ（ランダム・アクセス・メモリ）等を備えたマイクロコンピュータによって構成することができる。

【００３８】さらに、この制御系は、運転者の車両駆動力への要求度を示すアクセル開度αを検出するアクセルセンサ４５と、車速Ｖを検出する車速センサ４６とを備えている。それぞれのセンサ４５、４６で検出された検出値は車両制御装置４１へ供給される。

【００３９】車両制御装置４１は、ハイブリッド車両の全体を制御するもので、アクセルセンサ４５からのアクセル開度αと、車速センサ４６からの車速Ｖに応じたトルクＴＭ＊を決定し、これをモータトルク指令値ＴＭ＊としてモータ制御装置４３へ供給する。また、発電機１



る時に、ブレーキＢを開放して発電を行う。

【００５０】以下、ハイブリッド車両の制御動作について詳細に説明する。図６は、ハイブリッド車両の制御動作を示す、フローチャートである。アクセルセンサ４５からアクセル開度αを読み取り（ステップＳ１１）、アクセル開度αが２０％以下か否かを判断する（ステップＳ１２）。アクセル開度αが２０％以下である場合には、車両制御装置４１は、ブレーキＢが係合状態（ＯＮ状態）か否かを判断する（ステップＳ１３）。係合状態である場合には（ステップＳ１３：Ｙ）、そのままの状態を維持し、メインルーチンへリターンする。

【００５１】ブレーキＢが解除状態（ＯＦＦ状態）である場合には、つまり、アクセル開度αが２０％以下であり、かつブレーキＢが解除状態である場合（ステップＳ１３：Ｎ）には、発電機１６の回転を固定しても良いか否かを判断する。即ち、発電機回転数ＮＧの絶対値｜ＮＧ｜が、許容値△ＮＧ＊以下であるか否かを判断する（ステップＳ１４）。

【００５２】｜ＮＧ｜＜△ＮＧ＊である場合には（ステップＳ１４：Ｙ）、車両制御装置４１は、電磁バルブ５４にＯＮ信号を供給してブレーキＢを係合し（ステップＳ１８）、メインルーチンにリターンする。ブレーキＢの係合によって、発電機１６が固定され、発電機１６における電力ロスが抑制される。

【００５３】｜ＮＧ｜≧△ＮＧ＊である場合には（ステップＳ１４：Ｎ）、図５に従ってＮＧ＊＝０とし（ステップＳ１５）、これを発電機制御装置４４へ供給する（ステップＳ１６）。ここで、車両制御装置４１は、発電機制御装置４４を介して、発電機実回転数ＮＧをモニターし、ステップ１４と同様に、発電機回転数ＮＧの絶対値｜ＮＧ｜が、許容値△ＮＧ＊以下となったか否かを判断する（ステップＳ１７）。｜ＮＧ｜＜△ＮＧ＊となるまでステップＳ１７を繰り返し（ステップＳ１７：Ｎ）、発電機制御装置４４による制御によって、｜ＮＧ｜＜△ＮＧ＊となった時（ステップＳ１７：Ｙ）、車両制御装置４１は、電磁バルブ５４にＯＮ信号を供給してブレーキＢを係合し（ステップＳ１８）、メインルーチンにリターンする。

【００５４】ここで、ステップＳ１６において、目標回転数ＮＧ＊が供給された後、発電機制御装置４４が、実回転数ＮＧを目標回転数ＮＧ＊へ向けて制御する制御動作では、実回転数ＮＧの変化率が、予め定められた範囲である上限変化率△ＮＧＭＡＸ（ｒｐｍ／ｓｅｃ）を越えない範囲で実回転数ＮＧが制御される。発電機１６とエンジン１１は、プラネタリギヤユニット１３を介して連結されているため、発電機１６の回転数ＮＧを急激に制御すると、エンジン１１か吹き上がるなど、排気ガスの量や燃費に悪影響を及ぼす恐れがある。そこで、上記上限変化率△ＮＧＭＡＸは、上記悪影響を及ぼさない限界の変化率として設定されている。

【００５５】図７は、上限変化率△ＮＧＭＡＸを示すものである。図示されているように、上限変化率△ＮＧＭＡＸはアクセル開度αの値が大きい程大きくなるように設定されている。なお、この上限変化率△ＮＧＭＡＸは、アクセル開度αの関数として設定せずに、一定値としてもよい。

【００５６】ステップＳ１２において、ステップＳ１１で入力したアクセル開度αが２０％より大きい場合には、ブレーキＢが係合状態（ＯＮ状態）か否かを判断する（ステップＳ１９）。ブレーキＢが解除状態（ＯＦＦ状態）である場合には（ステップＳ１９：Ｎ）、車両制御装置４１は、図５に基づいて、アクセル開度αから発電機１６の目標回転数ＮＧ＊を決定し（ステップＳ２０）、これを発電機制御装置４４へ供給した後（ステップＳ２１）、メインルーチンにリターンする。　一方、ブレーキＢが係合状態である場合には（ステップＳ１９：Ｙ）、車両制御装置４１は、発電機１６の回転数を保持するため、発電機１６のトルクＴＧをエンジントルクＴＥによって定まる設定値ＴＧ＊に保持する（ステップＳ２２）。その後、車両制御装置４１は、電磁バルブ５４にＯＦＦ信号を供給し、ブレーキＢの係合を開放し解除状態（ＯＦＦ状態）とする（ステップＳ２３）。

【００５７】次に、本発明のハイブリッド車両の駆動装置の動作について、図８に示されているタイムチャートに基づいて説明する。図８に示されているように、時刻t_1で、アクセルが踏み込まれて、アクセル開度がα１からα２へ変化し、時刻t_2で、アクセル開度がα２からα１へ変化した場合の動作について説明する。ここで、α１＜２０％、α２＞２０％とする。

【００５８】アクセル開度がα１の状態では、ブレーキＢは係合（ＯＮ状態）され、発電機１６は固定されて、回転数がゼロの状態となっており、発電機トルクＴＧもゼロとなっている。また、モータトルクＴＭは、アクセル開度α１に応じたモータトルクTM_1となっている。

【００５９】時刻t_1において、アクセル開度がα１からα２へ変化すると、アクセル開度α２に応じた出力トルクを出力すべくモータトルクＴＭは、TM_1からTM_2へ上昇する。この時、ブレーキＢはＯＮ状態となっている（図８において点線Ａで示す。以下同じ）。

【００６０】ブレーキＢの解除によるエンジン１１の吹き上がりを防止するために、その時のエンジントルクＴＥによって定まる発電機トルクＴＧ＊に、発電機トルクを予め上昇させる。ＴＧ＝ＴＧ＊となった後、時刻t_{12}において、ブレーキＢを解除（ＯＦＦ）し、同時に発電機は、予め定められた回転数変化率以下で発電機回転数ＮＧを上昇させる（点線Ｂ）。本実施形態においては、発電機１６の目標回転数ＮＧ＊を指令している時に、常に発電機トルクＴＧを算出して補正トルク△ＴＭをくわえることにしている（点線Ｃ）。このため、図８に示されているように、モータトルクＴＭには、発電機トルク

ＴＧの変動に応じた補正トルク△ＴＭが加えられる（点線Ｄ）。

【００６１】発電機回転数ＮＧは、急激に上昇することなく（点線Ｅ）、目標回転数ＮＧ＊に到達する。この間、発電機回転数ＮＧの激変がないため、エンジン１１には、吹き上がりなどによる燃費の悪化や排出ガスの増加といった悪影響は生じない。

【００６２】目標回転数ＮＧ＊への到達と同時に、発電機１６は目標回転数ＮＧ＊を保持するように制御される。発電機回転数ＮＧの上昇が止まるので、発電機トルクＴＧの絶対値は回転数が上昇している時よりも大きくなる（点線Ｆ）。この間にもモータトルクＴＭには、補正トルク△ＴＭが加えられており（点線Ｇ）、発電機回転数ＮＧが目標回転数ＮＧ＊に到達すると、発電機トルクＴＧの絶対値が大きくなるので、それを補正するためにモータトルクＴＭは小さくなる（点線Ｈ）。

【００６３】アクセル開度がα２からα１へ変化すると、アクセル開度α１に応じた出力トルクを出力すべくモータトルクＴＭは、TM_2 からTM_1 へ下降する。この時、ブレーキＢはＯＦＦ状態となっている（点線Ｉ）。次に、発電機回転数ＮＧをブレーキ係合状態（ＯＮ）での回転数であるゼロにするべく、発電機トルクＴＧを増加させ、同時にモータトルクＴＭに対しては、発電機トルクＴＧの変動に応じた補正トルク△ＴＭが補正される（点線Ｊ）。発電機回転数ＮＧは、急激に変化することなく下降し（点線Ｋ）、△ＮＧ＊よりも小さくなった時に、時刻t_{22}で、ブレーキＢが係合（ＯＮ）される（点線Ｌ）。この間、発電機回転数ＮＧの激変がないため、エンジン１１には、吹き上がりなどによる燃費の悪化や排出ガスの増加といった悪影響は生じない。

【００６４】発電機回転数ＮＧが下降している間、モータトルクＴＭはトルク補正が行われており（点線Ｍ）、走行感覚の維持が図られており、ブレーキＢの係合とともに、発電機トルクＴＧが小さくなるのでモータトルクＴＭはその分大きくなるなる（点線Ｎ）。そして、ブレーキＢによって発電機１６が完全に固定された時に、発電機トルクＴＧがゼロとなる（点線Ｏ）。

【００６５】以上の説明は、アクセル開度αが２０％である状態を境として、ブレーキＢを係合解除する制御動作について説明したが、本発明においては、上記動作に限定されるものではなく、マニュアル操作によって、走行モードを発電機１６で発電しながら走行するモードと、発電機１６で発電せずに走行するモードとに切り換える場合にも適用でき、その他、エンジンブレーキを作用させるために発電機１６のロータ２１を固定する場合など、走行中に発電機１６のロータ２１を固定する場合に用いることができる。

【００６６】なお、上記説明した実施形態において用いられるブレーキＢはいかなる種類のブレーキでもよい。この場合、湿式ブレーキ、乾式ブレーキのいずれでもよいが、回転数を制御しやすい点で湿式ブレーキを用いることが好ましい。

【００６７】＜第２実施形態＞次に、本発明の第２実施形態について説明する。図９は、第２実施形態の駆動装置の構成を示す概念図である。本実施形態のハイブリッド車両では、プラネタリギヤユニット１３において、キャリヤＣＲとサンギヤＳとの間に係合手段であるクラッチＣが設けられており、第１実施形態において発電機１６に配設されていたブレーキＢは設けられていない。また、クラッチＣは、車両制御装置４１からＯＮ／ＯＦＦ信号が供給されるアクチュエータによって係合と解除が制御される。その他の構造については、第１実施形態と同様であるので、図１と同一構成に同一符号を付し、説明を省略する。

【００６８】第２実施形態の駆動装置の動作について説明する。クラッチＣは、通常走行時においては、解除状態（ＯＦＦ状態）となっており、加速時において、係合状態（ＯＮ状態）とされる。

【００６９】クラッチＣが解除されている通常走行時では、プラネタリギヤユニット１３はオープンとなっており、図２（Ｂ）に示されているように、サンギヤＳ、キャリヤＣＲ、リングギヤＲがそれぞれ独立して異なる回転数で回転している。本第２実施形態では、リングギヤＲの歯数がサンギヤＳの２倍となっているから、ユニット出力軸１４に対するエンジン１１のギヤ比は、２／３となっている。

【００７０】そして、クラッチＣが係合されている加速走行時では、プラネタリギヤユニット１３の各歯車要素は、一体回転となり各歯車要素の回転数は同一となる。この時のユニット出力軸１４に対するエンジン１１のギヤ比は１となり、クラッチＣが解除状態である時に比較して、エンジン１１からユニット出力軸１４に伝達される出力が１．５倍に増大する。これにより、駆動出力軸であるカウンタシャフト３１に伝達される出力が増大し、加速が行われる。

【００７１】次に、第２実施形態の制御動作について説明する。図１０は、制御動作を示すタイムチャートである。以下、アクセル開度をα１の状態から、α２へ増加させて加速し、加速終了後アクセル開度をα３へ変化させた場合の制御動作を例にして説明する。

【００７２】通常走行状態では、アクセル開度がα１で、クラッチＣは解除状態（ＯＦＦ状態）となっており、発電機１６の回転数ＮＧ、トルクＴＧおよびモータトルクＴＭは、それぞれアクセル開度α１および車速Ｖに応じた値に設定されている。

【００７３】時刻t_1において、加速するためにアクセル開度をα１からα２へ増加させると、アクセル開度α２に応じた出力トルクを出力すべくモータトルクＴＭは、TM_1 からTM_2 へ上昇する。この時、クラッチＣはＯＦＦ状態となっている（図８において点線ａで示

す。以下同じ）。

【００７４】発電機１６には、発電機回転数ＮＧをリングギヤＲに入力されている出力回転数ＮＯＵＴとするために、目標回転数ＮＧ＊$_2$をＮＯＵＴに設定し、発電機トルクＴＧを減少させる。これにより、発電機回転数ＮＧが目標回転数ＮＧ＊$_2$へ向けて増加し始める（点線ｂ）。同時にモータトルクＴＭに対しては、発電機トルクＴＧの変動に応じた補正トルク△ＴＭが補正される（点線ｃ）。発電機回転数ＮＧは、急激に変化することなく上昇し（点線ｄ）、実回転数ＮＧと目標回転数ＮＧ＊$_2$との差が△ＮＧ＊よりも小さくなった時に、時刻ｔ$_{12}$で、クラッチＣが係合（ＯＮ）される（点線ｇ）。ここで、△ＮＧ＊は、クラッチＣの摩擦材の消耗を大きくせず、運転者にショックを伝えない範囲で設定される値で、クラッチＣを係合させる時の、実回転数ＮＧと目標回転数ＮＧ＊$_2$との差の許容値である。

【００７５】時刻ｔ$_2$において、加速走行が終了してアクセル開度をα２からα３へ減少させ、通常走行とすると、アクセル開度αに応じてモータトルクＴＭを減少させる（点線ｊ）。また、発電機１６にトルクを加えない状態でクラッチＣを解除することによるエンジン１１の吹き上がりを抑制するために、その時のエンジントルクＴＥによって定まる発電機トルクＴＧ＊を求め、ＴＧ＊まで発電機トルクを予め上昇させる（点線ｉ）。

【００７６】ＴＧ＝ＴＧ＊となった後、時刻ｔ$_{22}$において、クラッチＣが解除（ＯＦＦ）され、同時に発電機回転数ＮＧは、回転数変化率の上限を越えないように目標回転数ＮＧ＊$_1$へ向けて下降し始める（点線ｋ）。また、モータトルクＴＭには、発電機トルクＴＧの変動に応じた補正トルク△ＴＭが加えられる（点線ｍ）。発電機回転数ＮＧは、急激に下降することなく（点線ｎ）、目標回転数ＮＧ＊$_1$に到達する。

【００７７】なお、上記説明した実施形態において用いられるクラッチＣは、湿式クラッチ、乾式クラッチのいずれでもよいが、係合時のショックを軽減できる点で湿式クラッチを用いることが好ましい。湿式クラッチを用いることで、クラッチＣ係合時のショックをより一層抑制することができる。

【００７８】また、上記係合手段であるクラッチＣは、第２の歯車要素であるサンギヤＳと第３の歯車要素であるリングギヤＲとの間に設けられていてもよく、また、キャリヤＣＲとリングギヤＲとの間に設けられていてもよい。この場合の、発電機回転数ＮＧの制御方法は、上記第２実施形態の場合と同様である。

【００７９】

【発明の効果】以上説明した請求項１に記載の発明は、係合手段を係合させる前と、係合させた後との間で、発電機の回転数の差が少なくなるので、係合手段による係合時のショックが抑制される。これにより、係合手段の耐久性が向上し、特に、摩擦材が受ける熱負荷が軽減されるため、摩擦材の耐久性が著しく向上する。また、係合時の衝撃を緩衝するアキュムレータ等の装置が不要となるので、駆動機構の簡略化と軽量化が実現できるとともに、緩衝装置のチューニング等が不要となる。さらに、摩擦材の経時変化や運転状態、温度の変化などから悪影響を受けることが少ないので、安定した衝撃抑制効果が継続して得られる。

【００８０】請求項２に記載の発明は、発電走行から非発電走行へ切り換える際の、発電機ロータ固定による衝撃を抑制することができる。

【００８１】請求項３に記載の発明は、例えば、通常走行から加速走行へ移る時のクラッチ係合による衝撃を抑制することができる。

【００８２】請求項４に記載の発明は、発電機回転数制御時に生ずるトルク変動を、モータトルクを補正して吸収するため、走行感覚を良好な状態に維持することができる。

【００８３】請求項５に記載の発明は、発電機回転数の変化率を予め定められた範囲内に制御することで、発電機回転数の急激な変化が抑制され、エンジンの燃費や排ガス量等に対する悪影響を少なくすることができる。

【図面の簡単な説明】

【図１】本発明の第１実施形態におけるハイブリッド車両の駆動装置を示す概念図である。

【図２】本発明の第１実施形態におけるプラネタリギヤユニットの概念図および速度線図である。

【図３】本発明の第１実施形態におけるプラネタリギヤユニットのトルク線図である。

【図４】本発明の第１実施形態における制御系の構成を示すブロック図である。

【図５】本発明の第１実施形態におけるハイブリッド車両の目標回転数とスロットル開度との関係を示す説明図である。

【図６】本発明の第１実施形態における車両制御装置の制御動作を示すフローチャートである。

【図７】本発明の第１実施形態における発電機回転数の上限変化率とアクセル開度との関係を示す説明図である。

【図８】本発明の第１実施形態における車両制御装置の制御動作を示すタイムチャートである。

【図９】本発明の第２実施形態におけるハイブリッド車両の駆動装置を示す概念図である。

【図１０】本発明の第２実施形態における車両制御装置の制御動作を示すタイムチャートである。

【符号の説明】

１１	エンジン
１３	プラネタリギヤユニット（差動歯車装置）
１６	発電機
２１	ロータ

15

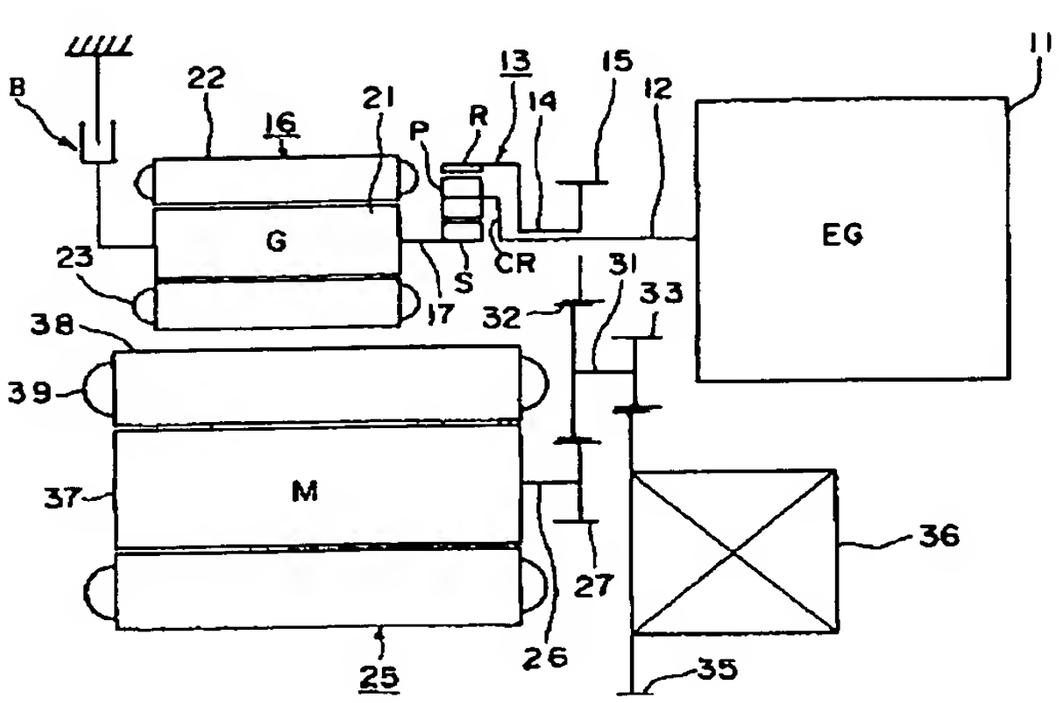
２５	電気モータ
３１	カウンタシャフト（駆動出力軸）
４１	車両制御装置
４２	エンジン制御装置
４３	モータ制御装置
４４	発電機制御装置
４５	アクセルセンサ

【図１】

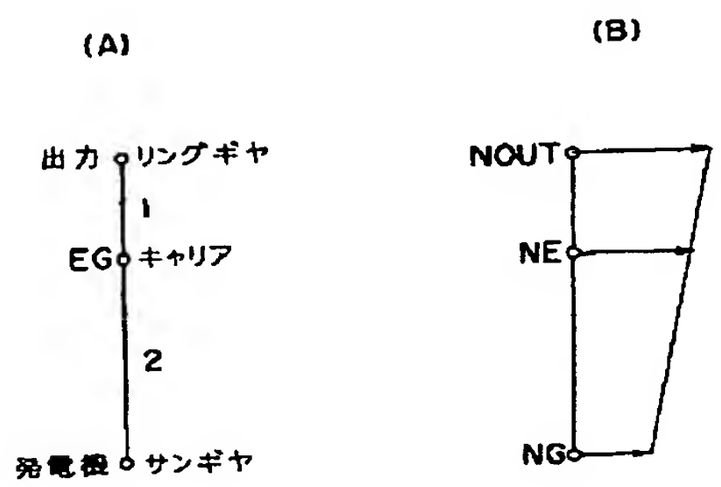
16

＊４６	車速センサ
５４	電磁バルブ
Ｂ	ブレーキ（係合手段）
Ｃ	クラッチ（係合手段）
ＣＲ	キャリヤ（第１歯車要素）
Ｓ	サンギヤ（第２歯車要素）
＊　Ｒ	リングギヤ（第３歯車要素）

【図２】

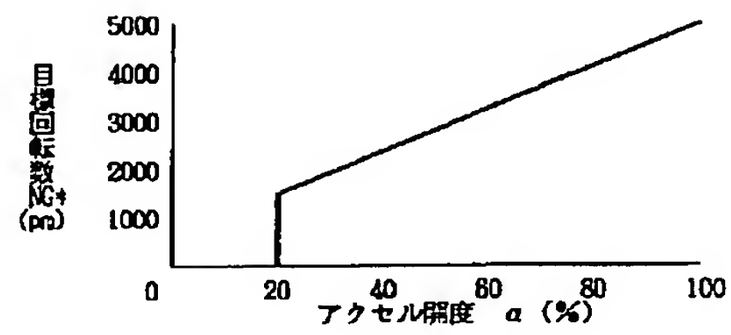


【図３】

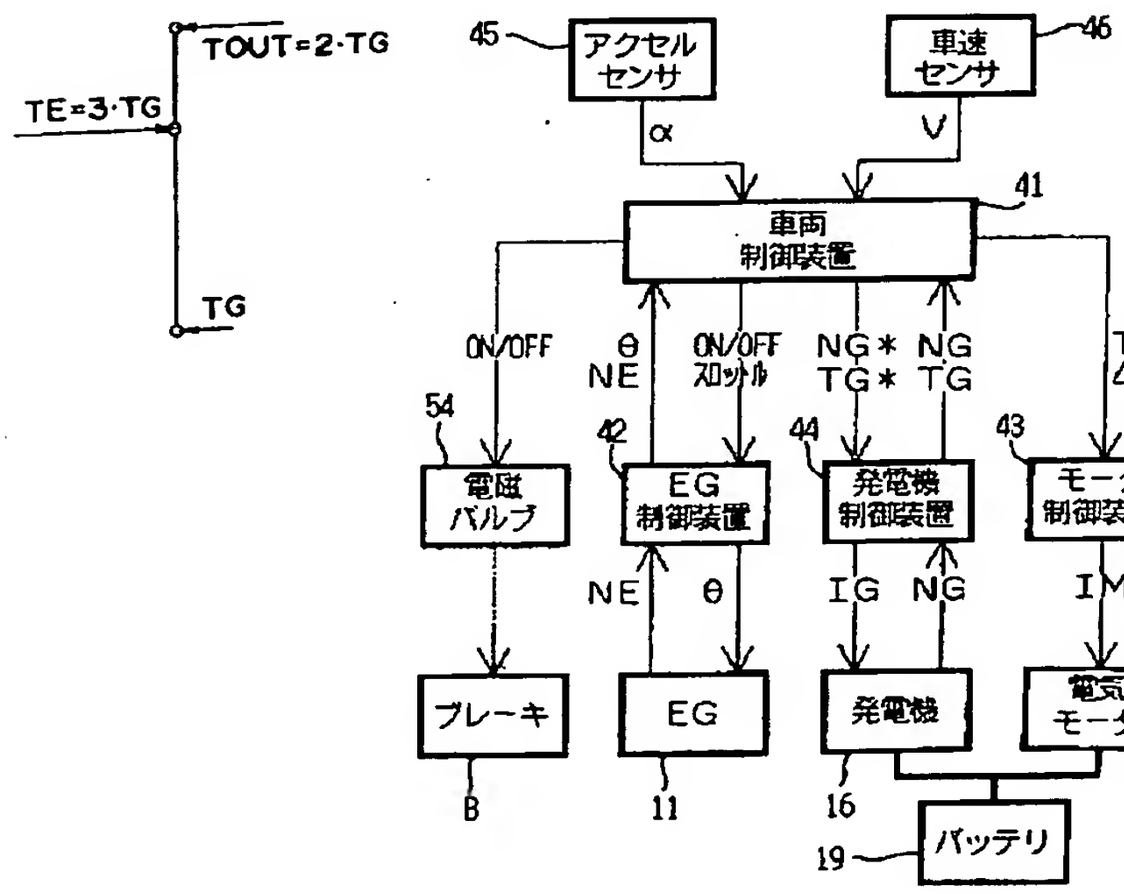


【図４】

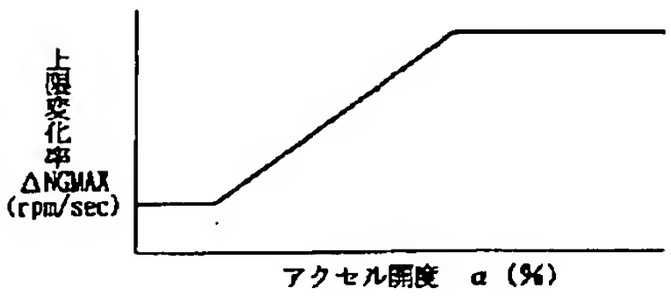
【図５】



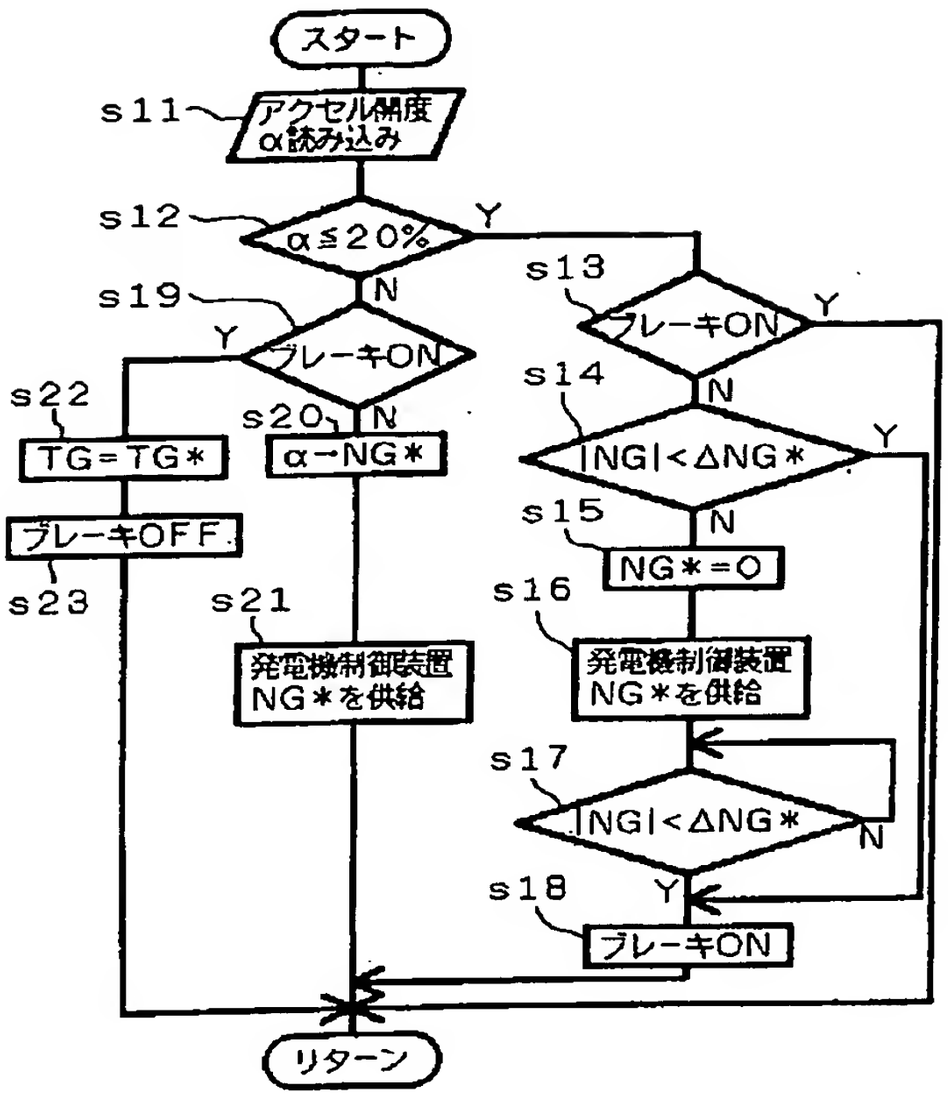
【図７】



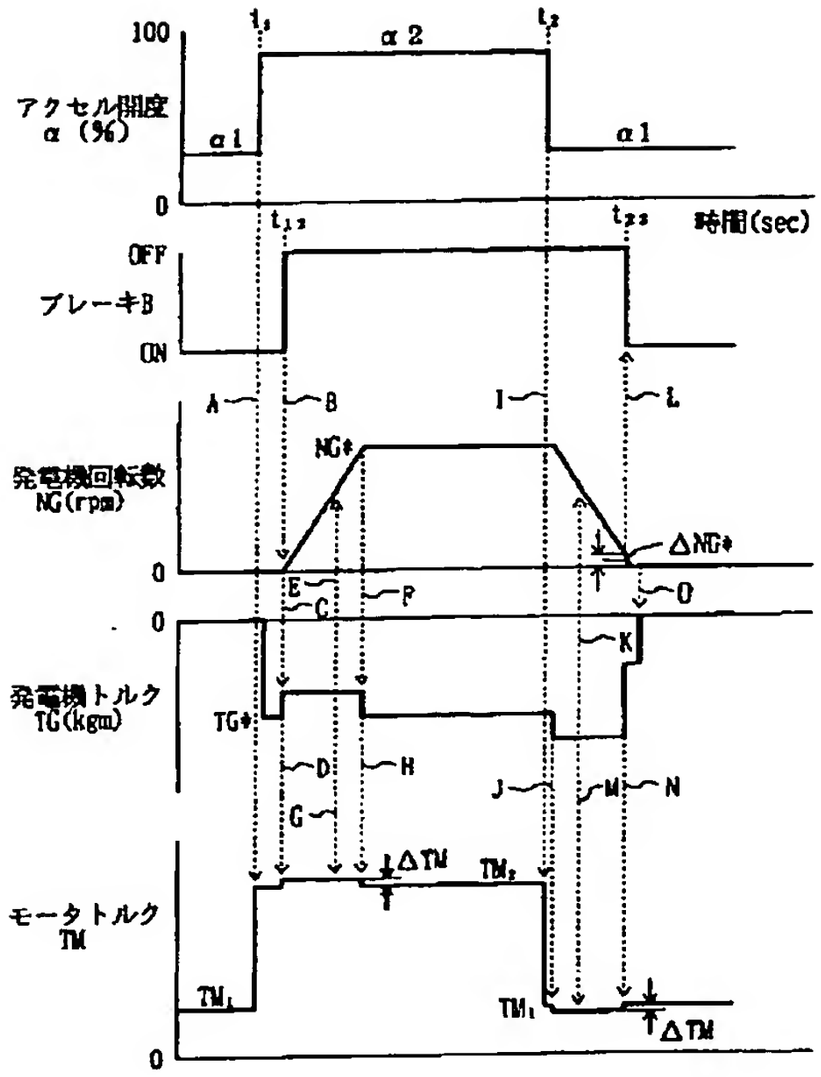
【図６】



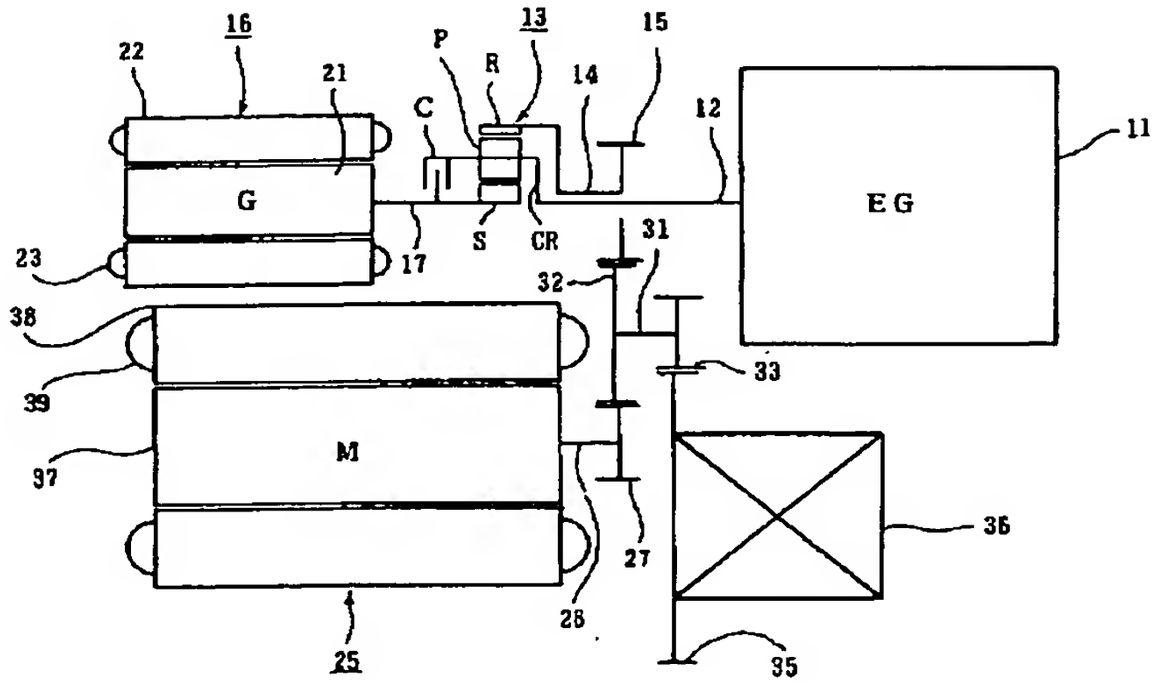
【図６】


スタート
s11
アクセル開度
α読み込み
s12
α≦20%
Y
N
s19
ブレーキON
Y
N
s22
TG=TG*
ブレーキOFF
s23
s20
α−NG*
s21
発電機制御装置
NG*を供給
s13
ブレーキON
Y
N
s14
|NG|<ΔNG*
Y
N
s15
NG*=0
s16
発電機制御装置
NG*を供給
s17
|NG|<ΔNG*
N
Y
s18
ブレーキON
リターン

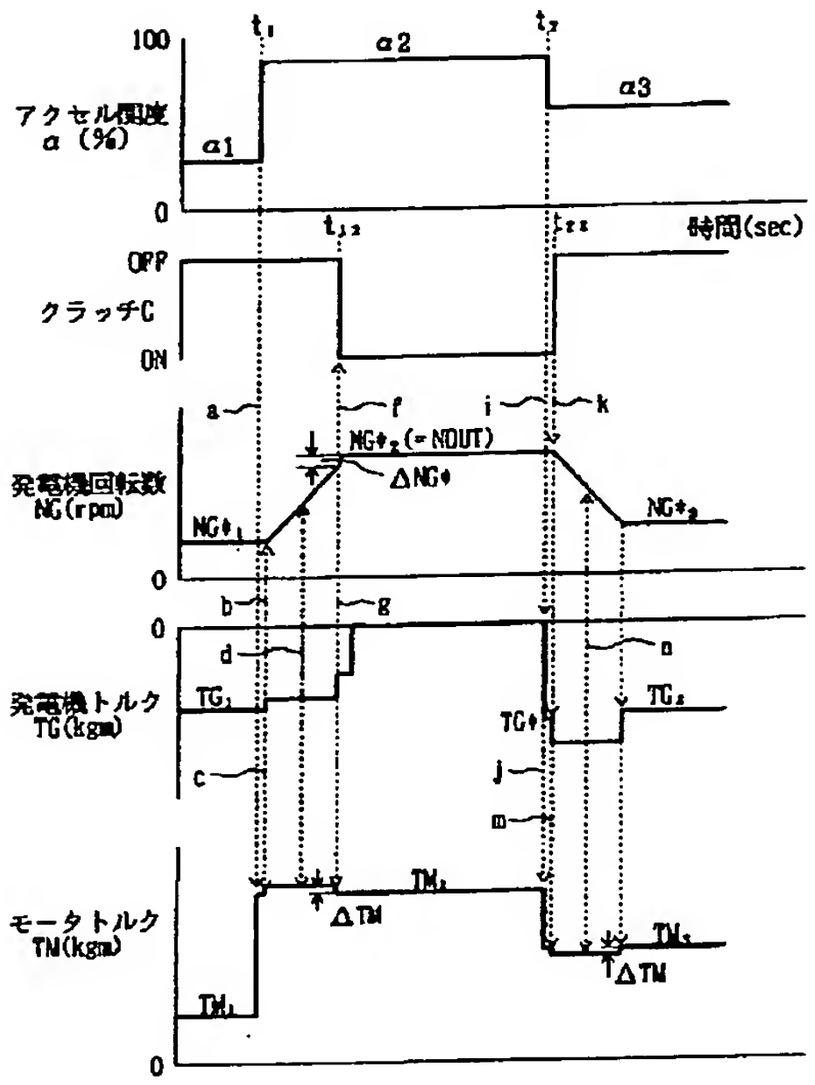
【図８】


100
α2
α1
アクセル開度
α（%）
0
時間(sec)
OFF
ON
ブレーキB
A
B
I
L
NG*
ΔNG*
発電機回転数
NG(rpm)
E
C
P
O
K
TG*
D
H
G
J
M
N
ΔTM
TM2
TM1
発電機トルク
TG(kgm)
モータトルク
TM

【図９】


16
22
21
P
R
13
14
15
C
12
11
G
EG
S
CR
31
23
17
32
38
33
39
M
37
36
27
26
25
35

【図１０】


100
0
アクセル開度
α（%）
α1
α2
α3
t1
t2
時間(sec)
ON
OFF
クラッチC
a
b
c
d
e
f
g
i
j
k
m
n
発電機回転数
NG(rpm)
NGΦ1
NGΦ2(=NOUT)
ΔNGΦ
NGΦ2
発電機トルク
TG(kgm)
TG1
TGΦ
TG2
モータトルク
TM(kgm)
TM1
ΔTM
TM2
ΔTM

【公報種別】特許法第１７条の２の規定による補正の掲載
【部門区分】第２部門第５区分
【発行日】平成１１年（１９９９）１１月２日

【公開番号】特開平９－１５６３８７
【公開日】平成９年（１９９７）６月１７日
【年通号数】公開特許公報９－１５６４
【出願番号】特願平７－３４４５４２
【国際特許分類第６版】
B60K 17/04
B60L 11/14
H02P 9/04
【ＦＩ】
B60K 17/04 G
B60L 11/14
H02P 9/04 L

【手続補正書】
【提出日】平成１１年２月９日
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】特許請求の範囲
【補正方法】変更
【補正内容】
【特許請求の範囲】
【請求項１】　エンジンと、
回転数制御可能な発電機と、
駆動輪へ駆動力を伝達する駆動出力軸と、
前記駆動出力軸に連結された電気モータと、
第１の歯車要素が前記エンジンの出力軸に連結され、第２の歯車要素が前記発電機のロータに連結され、第３の歯車要素が前記駆動出力軸に連結された差動歯車装置と、
前記発電機のロータと係止部材との間に配設された係合手段と、
前記発電機の回転数を制御する発電機制御手段と、
前記発電機制御手段によって制御されたロータと前記係止部材との相対回転数が、予め定められた範囲内になったときに、前記係合手段を係合状態とする係合制御手段とを備えることを特徴とするハイブリッド車両。
【請求項２】　前記係止部材は、前記発電機のロータを固定するケースである請求項１に記載のハイブリッド車両。
【請求項３】　前記係止部材は、前記第１の歯車要素と前記第３の歯車要素の内いずれか一方である請求項１に記載のハイブリッド車両。
【請求項４】　前記発電機制御手段は、前記発電機の回転数の変化率を予め定められた範囲内に制御する請求項１ないし３のいずれかに記載のハイブリッド車両。
【手続補正２】
【補正対象書類名】明細書
【補正対象項目名】０００９
【補正方法】変更
【補正内容】
【０００９】（１）　エンジンと、回転数制御可能な発電機と、駆動輪へ駆動力を伝動する駆動出力軸と、前記駆動出力軸に連結された電気モータと、第１の歯車要素が前記エンジンの出力軸に連結され、第２の歯車要素が前記発電機のロータに連結され、第３の歯車要素が前記駆動出力軸に連結された差動歯車装置と、前記発電機のロータと係止部材との間に配設された係合手段と、前記発電機の回転数を制御する発電機制御手段と、前記発電機制御手段によって制御されたロータと前記係止部材との相対回転数が、予め定められた範囲内になったときに、前記係合手段を係合状態とする係合制御手段とを備えることを特徴とするハイブリッド車両。
【手続補正３】
【補正対象書類名】明細書
【補正対象項目名】００１２
【補正方法】削除
【手続補正４】
【補正対象書類名】明細書
【補正対象項目名】００１３
【補正方法】変更
【補正内容】
【００１３】（４）　前記発電機制御手段は、前記発電機の回転数の変化率を予め定められた範囲内に制御する上記（１）ないし（３）のいずれかに記載のハイブリッド車両。
【手続補正５】
【補正対象書類名】明細書
【補正対象項目名】００３２

【補正方法】変更
【補正内容】
【００３２】となる。また、リングギヤRからユニット出力軸１４に出力されるトルク（以下「リングギヤトルク」という）をＴＲ（＝ＴＯＵＴ）とし、エンジン１１のトルク（以下「エンジントルク」という）をＴＥとし、発電機トルクをＴＧとしたとき、ＴＲ、ＴＥ、ＴＧの関係は、図３に示されているように、
【手続補正６】
【補正対象書類名】明細書
【補正対象項目名】００３７
【補正方法】変更
【補正内容】
【００３７】次に、本発明のハイブリッド車両の制御系について、図４のブロック図に基づいて詳細に説明する。本実施形態の制御系を構成する制御手段は、車両制御装置４１と、エンジン制御装置４２と、モータ制御装置４３と、発電機制御装置４４とを有している。これらの制御装置４１、４２、４３、４４は、例えばＣＰＵ（中央処理装置）、各種プログラムやデータが格納されたＲＯＭ（リード・オンリー・メモリ）、ワーキングエリアとして使用されるＲＡＭ（ランダム・アクセス・メモリ）等を備えたマイクロコンピュータによって構成することができる。
【手続補正７】
【補正対象書類名】明細書
【補正対象項目名】００７６
【補正方法】変更
【補正内容】
【００７６】ＴＧ＝ＴＧ＊となった後、時刻t_{22}において、クラッチＣが解除（ＯＦＦ）され、同時に発電機回転数ＮＧは、回転数変化率の上限を越えないように目標回転数ＮＧ＊₃へ向けて下降し始める（点線ｋ）。また、モータトルクＴＭには、発電機トルクＴＧの変動に応じた補正トルクΔＴＭが加えられる（点線ｍ）。発電機回転数ＮＧは、急激に下降することなく（点線ｎ）、目標回転数ＮＧ＊₃に到着する。以上のように、発電機制御手段によって発電機の回転数を制御すると、差動歯車装置を介して駆動出力軸に出力される出力トルクが変動する。ここで、駆動出力軸に連結されている電気モータのモータ出力トルクを、トルク補正手段により、出力トルクの変動に応じて補正することにより、走行感覚を損なうことなく、係合手段の係合ができる。発電機回転数制御時に生ずるトルク変動を、モータトルクを補正して吸収するため、走行感覚を良好な状態に維持することができる。
【手続補正８】
【補正対象書類名】明細書
【補正対象項目名】００８２
【補正方法】削除
【手続補正９】
【補正対象書類名】明細書
【補正対象項目名】００８３
【補正方法】変更
【補正内容】
【００８３】請求項４に記載の発明は、発電機回転数の変化率を予め定められた範囲内に制御することで、発電機回転数の急激な変化が抑制され、エンジンの燃費や排ガス量等に対する悪影響を少なくすることができる。